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THE WATER SAVING, INCREASING WATER USE EFFICIENCY AND WATER PRODUCTIVITY OF MELON BY WATER RETENTION TECHNIQUE

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ABSTRACT

The causes of water scarcity in Iraq is result of climate changes and the lack of water from the source, therefore, it necessitated searching for modern methods to conserve water and reduce its consumption and rationing. A modern technology in agriculture by set up polyathelines sheet under the root zones of plant was adopted for conserving thewaterirrigation into plantroot zones, to reduce waterlosses of field, increase the water usage efficiency and econimecals water productivities. The our search, the sheets was set up below rootzones of melon crop at the summer planting season 2022 by using the freefield. The studies were conducted in a farm pace in Babylon province inSadat-Al Hindyai Town. The drip-irrigation system was usage in wateringsystem. Two treatments were used, in plot A plastic sheet is used and plot B without sheet. The supplied irrigation and irrigation time are estimated, the yield, the water utilizeing Efficiency and water-productivity of crop which comparing with the 2 treatments. The plot A is increased 3.92% from plot B. In coliclosion show that water-utilizeefficiency for the plot A is higher than plot B by 22.62%. The water productivity is increasing of plot A comparing with plot B by 20.65%. The water saving in plot A was 19.6% comparing with plot B. The reducing in number of plants watering at plotA gave 11% comparing with plot B. The aim of the research is to obtain on the best ways to reduce water application of filed and reduction the losses of water by deep percolation and evaporation. This technology is helping in reducing irrigation water requirements also increasing productivity.

KEYWORD:Water Use Efficiency (WUE), Water productivity(WP),cup evapotranspiration,water irrigation and quantity.

1. INTRODUCTION

This study is researched the important of installation the poliathelinesheet of undersurface waterretentions technique (SWRT) under the croproot zones on water utilizeefficiency (WUE) and thewater productivities (WP) of melon crop in freefields and compering with the results unused SWRT to reduce irrigation and increase of yield. Isa, H. A. M.,2016 do the impacting of set up SWRT polyatheline under the croproot zones with WUE of crop (hot pepper) and tomatoes plants inclose field. They did in Diyala and Najaf provinces . He used SWRTs sheets plots of T1, organic matter of T2 plot, tillage of T3 plots and without tillage of T4 treatments. From resulting explained the WUE of hot-pepper into Diyalaprovince by using SWRT was higher from other treatments via 233percent.in addition to WUE of chili pepper in Najafprovince was higher from other traetments via 165 percent.

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Hommadi, A.H., 2018 used the SWRT membrane below root zone of hot pepper and root zone of okra to obtain on increasing of WUE and WP. He conducted on two different sites through 2016-2017; the field of Sadat AlHindya belong to Babil governorate,Iraq. Using drip watering system was utilized of watering. Increasing in WUE and WP in the plots with SWRT. Using WUE of chili pepper and okra-crop was higher from other treatments via 54 percent and percent, arespectively. Chili pepper with okra crop WP by using a SWRT treatments technique was higher-than other treatments via 89 % and 108 %, respectively. Hommadi, Ali Hassan and Almasraf, Sabah Anwer, 2019 used SWRT treatments polyethelinesheet technique in order toreduce the deep-percolation in Sadat Alhindyia township in Babylon governorate. The field cultivated by squash crop and irrigated by trickle irrigation and used two treatment plots, the first plots used the SWRT under rootzones the squash plant with aspect ratios two to one and the second plot without SWRT technique. The researches obtained on increasing of WUE and WP of SWRT plot comparing with without SWRT plot by 30.17% and 60.3% ,respectively. Amirpour, M..et. a.l.,2016. investigate of impacting SWRTtretment on-water contents, number irrigations with soil temperature. SWRT technique was installed at different depths in light texture of soil. water and soil temperature was best due to using SWRT sheet and the number of irrigations was lest. In result the SWRT sheet gave good effect by water retention for crop through whole depths. SWRT sheet with mulch improved sandy texture soil by saving water and food of crop. DuranY et al.,2021 estimated melon yield and water consumed by the plant was arranged 129.7mm also 418.5 mm during 2016 and arranged 161.8mm and 428.6 mm during2017. Maximum yield was 52.9 ton/hectar. Majid R and Mohammad G, 2008 water productivity values for melon between 2.46–8.49 kg/m^3 and thus variability of water productivity canbe attributed to globale warming and watering management among treatments. Study aim in orderto decrease of water application and increase of production. This method helps to fill the need of the population by using modern method.

2. THEMATERIALS WITH THEMETHODS

The research region area sites in Sadt Al-Hindya Town in Babil province 81 Kilmeter of Baghdadcapital. The latitud is 32º35' 33"N andlongituding 44º 20'24"E, also altituding: 31 meter. The **Figure.1** explains GIS maps of this sites. Analysis soil was conducted in the laboratory of the National-Center of WaterResourcesManagement of Ministry-Water-Resources/Iraq. Analysis study included soil-texture and field-capacity-(F.C) with permanent-wilting point-(P.W.P) also specific-gravity (bulk density/water density). Soil-texture classification was the clay-loam soil (the aim using heavy, medium or light texture to save water for long time) for depth ranges (from) 0 to1.0 meter. F.C. was 44.60 percent via volume as well P.W.P was 25.0 percent via volume. The specific gravity of clay-loam texturesoil was 1.320 (without unit because of it is bulk density dividing by water density) and melon allowable-depletion has 40 % and the highest of effective-rootzone was 80-150 centimeter **[6].** The root zone of melon crop was 80cm**.**

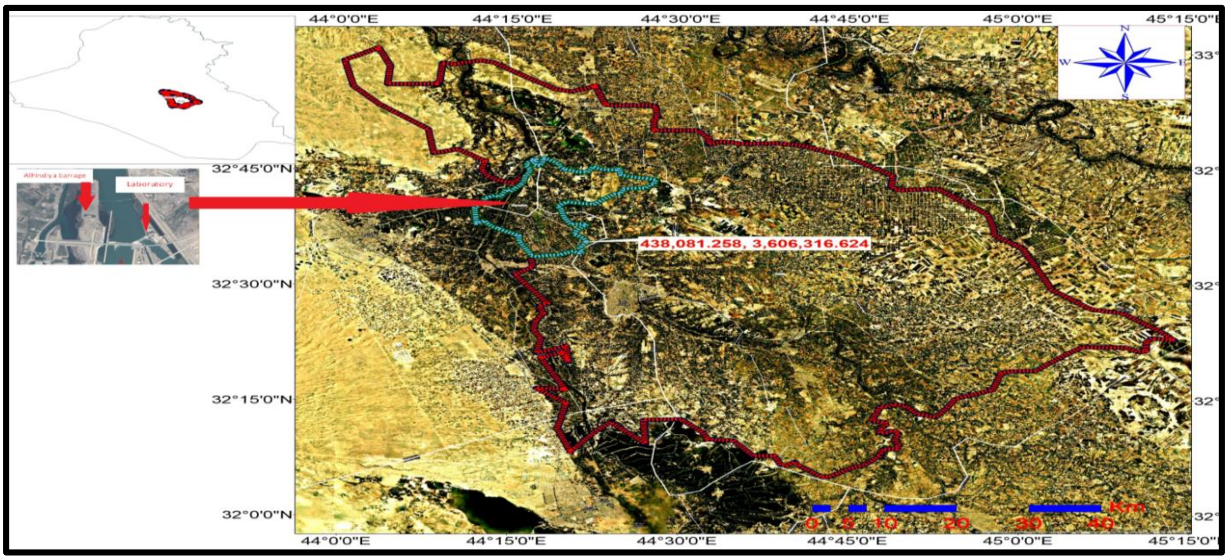


Fig.(1):-GIS maps of the locations

3. TheTreatment,methodology, Experimental work during field study

The 2 treatmentplots were used. The one-treatments A with SWRT polyathelinesheet-that put in partial part under land-surface. The 2 treatments B do not use SWRT. First and second treatments has cultivated region 2*5.5=11 m^2, with total area 4.4*6.15=27 m^2. The treatment poliathelyne-sheet of thickness one handern micro meter set up under the land-surface in 15 cm deep under land surface of PRZ melon crop same U leter-shape has aspect-ratios three:one (the width 30cm and heights 10cm). Installation operation of the treatments polyethelinesheet is conducted via manually working as explain **at Figure.2**. The drawing installing section of location-work was explainin **Figure3.** Melon utilized in working seeded has space of 19 centimeter. Surface drip-irrigation work is utilized as wll dripper space = 19 cm, in this work all plants supplied with one emitter of average discharge of 20 mil litter/min equal to 1.2 litter/s. Date of planting the melon was started at end of April 2022 and the harvest date was 10August 2022. A water pump was provided drip irrigation system with maximum flow rate 30 l/min and max. head 30 meter and a power of 1/2 horse power.

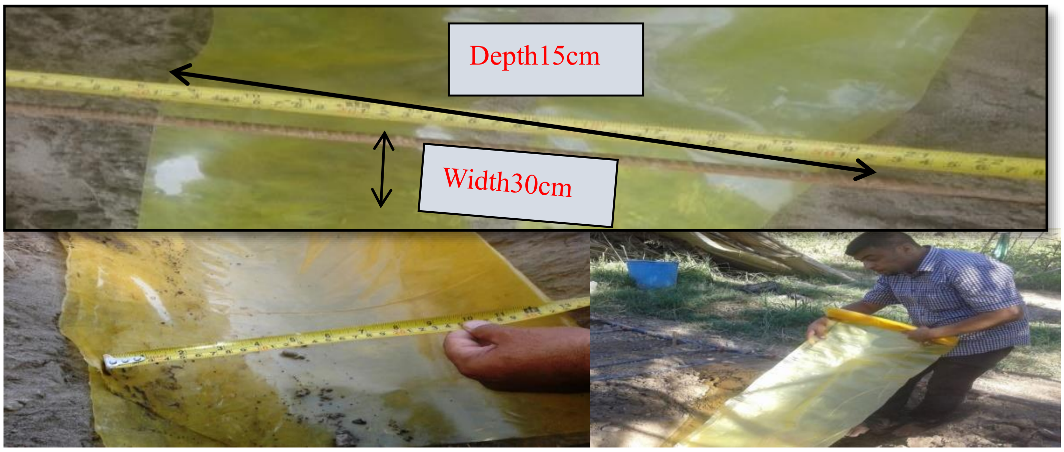


Fig.(2):-setting up operation of the polyethylenes-sheet under ground-surface

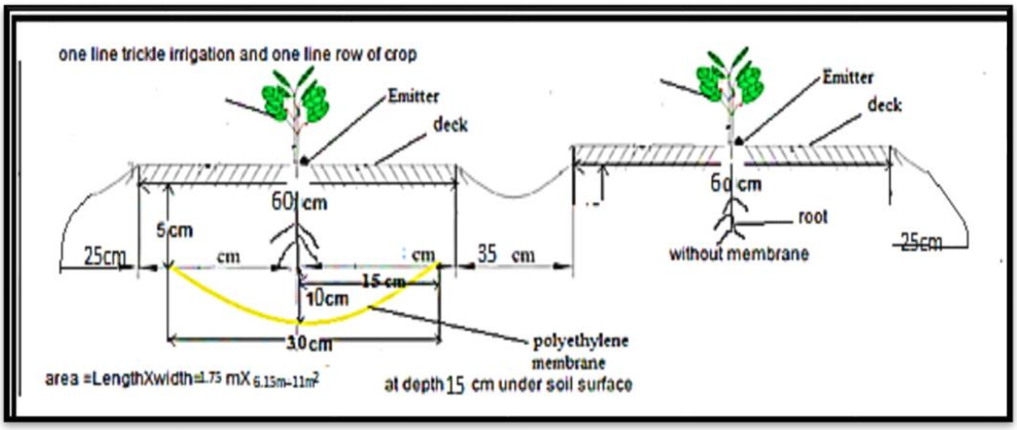


Fig.(3):-Cross section of treatments.

4. Yield, Water Usage Efficiency-(WUE.) and Water Productivities-(WP.)

4.1 Yields of productivity

calculation total crop yield from. datestarting of seeding of melon crop till to end of the harvest season. Total yield melon measures by Mgh^{-1} (kg/m^2) depending on theFAO-1982

$$Crops\text{-}Yield = \frac{summation\ cropsmass-(kg)}{summation\ croparea-(m^2)} \quad (1)$$

4.2 Water-usage-efficiency

theWater utilizeefficiency-(WUE) is the results of yield/applied water. water use efficiency (kg/m^3) was used depending on the researchersin refrence(Naroua, I., S., et.al.,-2014):

$$WUE = \frac{yields.(\frac{Kg}{m^2})}{summation\ of\ applied\ water.(m)} \quad (2)$$

4.3 economicalyWater-productivity

Economicaly.Water-productivity.(WP) is a returns/ volumes-of supplied waters.(m^3). The value of return of Iraq by Dynars(IQ) which = production × selling price in the market (Molden, D.,et al.,2010) :

$$W\,P = \frac{\text{Retun}}{\text{volume water applied}(m^3)} \quad (3)$$

Table. 1 show water-chracterstics (acidity and alkality-pH, water-temperature, irrigation electric-conductivity (ECi) and total dissolved salt (TDS) and electric conductivity of soil ECe.

Table (1):- water properties (PH, temperature, ECi, TDS and saturatedsoil extractedECe

Electric conductivities of river waters(ECi) (dicicemens/m)	Electric conductivities of saturated soils (ECe) before irrigation by water river	Electric conductivities of saturated soils (soilECe) (diciemens/m) after first irrigation of water river	Electric conductivities of saturated (soilECe) (ds/m) afterof third irrigation of water river	Electric conductivities of saturated (soilECe) (ds/m) afterof last irrigation of water river before harvesting
1.5	1.55	1.6	1.64	1.78

5.RESULT AND DISCUSSION

5.1 numberof Irrigations and the Waterapplication

Irrigation-scheduling of was carried out forthe two poltsduring planting and growthseason and the soils. allowableswater-depletion (theAD) equal 40 % from available-water (theAW). Themonths, Supplieddepth water and No.of irrigation of melon of thetreatments A also B for the planting till harvestingseason 2022 are showed in Table2. The summation applied depth-water in treatments A =262 milimeter and treatments B= 326 milimeter. Conserving of water in the A 19.6 %.In addition to, No. of irrigations in A =16 an B=18, with decreasing in No.of irrigation in A via 11 %. TheTreatments A is conservation thewater during ofsoil morethan B because od utilizing polyethelinesheet technuque. The soilelectrical-conductivity(.theECe).tbefore irrigation is 1.5ds/m and after irrigation via river water is 1.59ds/m and 1.55 ds/m of A and B, respectively. The ECi of river was 1.4ds/m.

Table (2):- shows Months, water depths and No.of irrigations A and B during the plants season 2022.

Months	Applying water depth (mm) treatmentsA.	Frequency of irrigations in Aplot.	Applying water depth (mm) treatmentsB.	Frequency of irrigations in Bplot.
April	44.7	3	44.7	3
May	34.8	4	45.3	4
June	122.5	6	170	8
July	60	3	66	3
Total	262	16	326	18

5.2 Reference evapotranspiration (ET_o) by meteorologically factors

Modify-Penman-Monteith equationis used the reference evapotranspirations (the ET_o) into free-field (Allen et al., 1998):

$$ET_o = \frac{0.408*\Delta(R_n-G)+\gamma\frac{900}{T+237}U_2(e_s-e_a)}{\Delta+\gamma(1+0.34U_2)} \quad (4)$$

Where:

ET_o: potentialevapotranspiration (mm deving by day), R_n: net-radiation from plant surfaces (MJ/m^2 dividing on day), G: thesoil heat-fluxdensity (sampling as MegaJ/ squarem /day), T_{mean}: average daily of air temperatures in two meter height (simbles ^{o}C), U_2: the wind of speeds at 2metersheight (m/s), e_s: saturaed vapor pressures kiloPaskal, e_a: realvapor pressures kiloPaskal, e_s-e_a : saturating vapor-pressure laking kilo Paskal, Δ: slope of vapor pressures curves masured by the kilo Paskal per degree of silesian, and

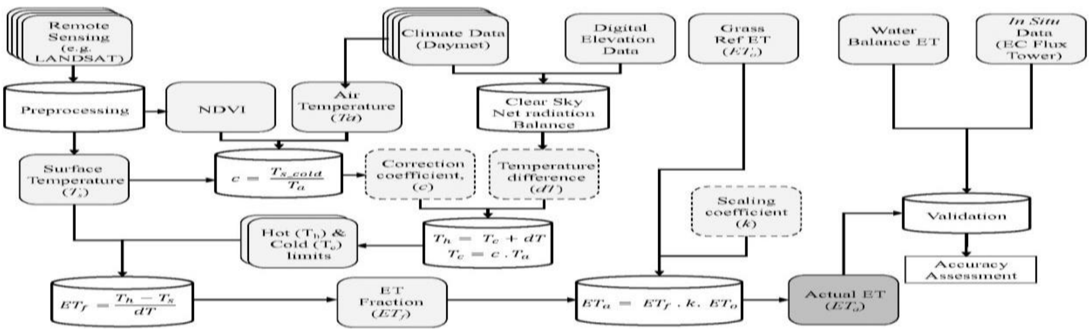
γ: psychrometric constant masured by kilo Pascal degree of silesian. And

$$\Delta = \frac{4098\left[0.6108\ exp\left(\frac{17.27Tmean}{Tmean+237.3}\right)\right]}{(Tmean+237.3)^2} \qquad (5)$$

$$\gamma = 0.6650 * 10^{(-3)} * Pa \qquad (6)$$

The Pa = atmospheric-pressures measure kilo Pascal.

Calculation crop evapotranspiration ETa by remote sensing methodology by NDVI during the growing seasons of melon crop started from start, growingdevelopment, mid and last of season-2022. These ways include thesurface-energy-Balance Indices. In this research we utilize the Operational Simplifying-Surface-Energies Balance simplified asSSEBop) approach Gabrel B. Senay, et. al.,./2013.The SSEBop approach pre-defines is uniqued = hot per dry and cold per wet" limited values for each-pixel, that utilizes a set of reference-hot,and-cold pixel-pairs applicable for apecific area. Calculation evapo-transpiration is need to utilize in SSEBopmodel that include the surface and air-temperature, as well refrence ETo. The whole approach of the SSEBopmodels as explain at Fig. 4.



5.3 Yields-productivity and-Water usage Efficiency-of Melon

The production plant (yield) was calculating via the Eq. 1 to the poltsA is 1.02 kg/m^2 andB is 0.98 kg/m^2. The production of summation yield of A was more than the B via 3.92 %. This decreasing insummation cropyield of in A which causes the water also fertelizingandnutrient that are retaining of root-zone on the polyethelinesheet. The Table 3 is shown the monthly cropyield of melon of July for A with B. Increasing the yield in A was 3.92%.in addition to, values of water utilizing efficiency simbled by WUE for A with B calculated via applcation

Eq. 2 were A=3.89 kg/m^3 and B= 3.01 kg/m^3. The rising of value WUE in treatmentplot A which compared withs treatmentplot B is 22.62 %. The polyetheline-membranesheets are helped to conserving cropwater of soil, fertilizing-nutrient and thepesticide into the root-zone section under land surface within roots of crops and save soilwater from losses via deep-percolation and go to ground water without penfit it. Fig. 5 and Fig.6 shows the cropyield and WUE value of melon for treatmentplots A with B.

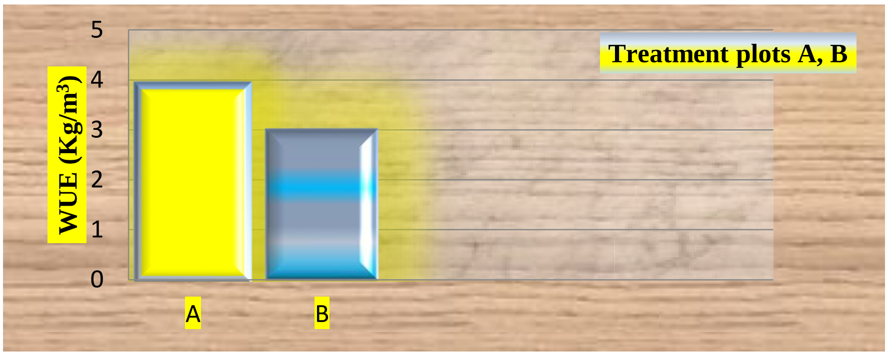


Fig.(5):-Shows the WUE values of melon crop for treatments plots A and B during growing season 2022.

Table (3):- Months with cropsyield of melon for treatmentplots A with B of plantingseason 2022.

Months	cropyield for A (kg per square meter)	cropyield for B (kg per square meter)
Total sum July	1.02	0.98

5.4 Water Productivity

water productivity (WP) which is used via application of Equation 3. The WP of treatmentplots A is 20000 Iraqi dinar each 1cubic meter and B was15870 ID/m^3 . Table 4 explains the cropproduction, summation of selling-price, return , applied volume of water and economic water productivity of melon for plots A and B. The value of WP in plot A was higher than plot B by 20.65%. Increasing the value of the yield and decreasing in quantity of applied water was because of the sheet under the root zone that helps on conserve water, fertilizer and pesticide in root zone. Fig. 6 shows the comparison in WP of melon between treatments plots A and B in the growing season 2022. Table 5 shows the value of reference (ETo) , actual evapotranspiration (ETa) and effective rainfall (P).

Table (5):- cropproduction, summation-selling-price, cropreturn, supplingvolume of cropwater and cropwater productivity for treatmentplots A withB.

Parameters	Plot A	Plot B
cropProduction (kg) weight of crop after harvesting	**11.2**	**10.8**
Mean-summation-selling prices (Iraqi dinarID)	500ID	500ID
Total selling (iraqidinarID)=production* Average total selling price	**5600**	**5400**
Cost (ID)(Seed,membrane,pesticides,fertilize)	2000	1750
Return (ID)= Total selling (ID)- Cost (ID)	**3600**	**3650**
Applied volume of water (m3)	0.18	0.23

Economic water productivity (ID/m3)=Return(ID)/ Applied volume of water (m3)	**20000**	**15870**

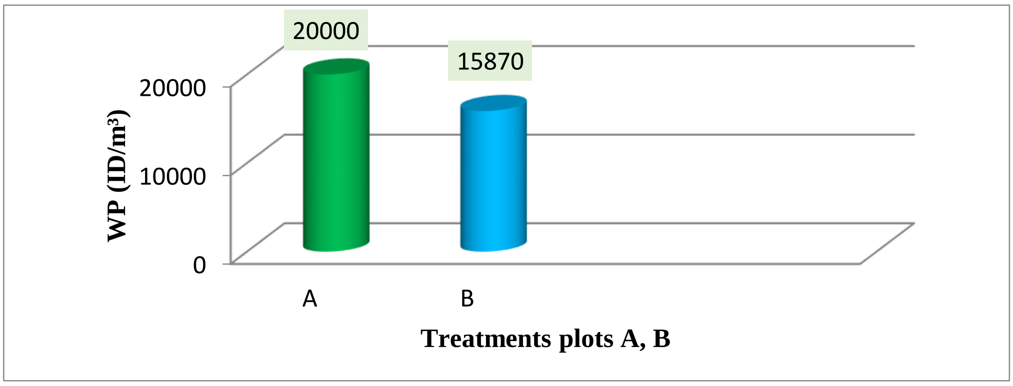


Fig.(6):-Cropwater productivity of treatmentpolts A with B of melon in the growingseason2022.

The Fig.7 shows the value of ETa Through 27 July by python program and SSEBOP models calculation and Fig. 8 shows the value of ETa, NDVI and LST during 27 July 2022).

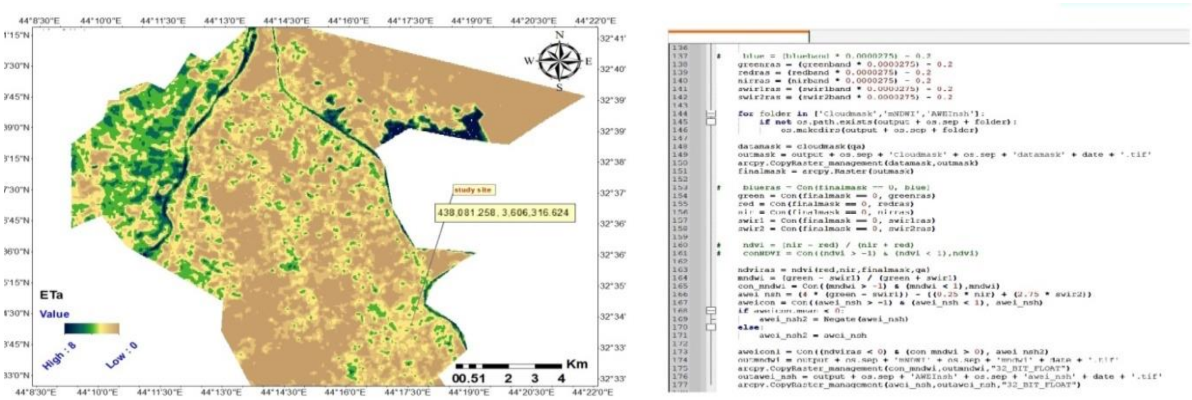


Fig.(7):-The value of ETa Through 27 July 2022by python program and SSEBOP models calculation

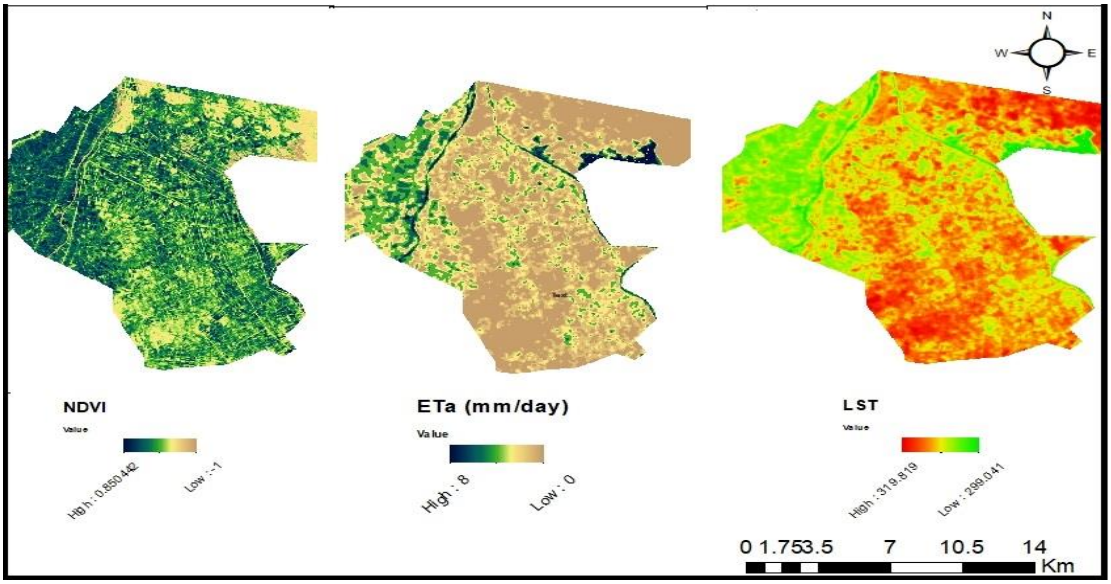


Fig.(8):-the value of ETa,NDVI and LST Through 27 July 2022

From model calculated the highest monthly actual evapotranspiration in July which it reached 150mm/month and monthly actual evapotranspiration in July which it reached 8mm/day during 2022 year.

5.5 The Canadian Water Quality

symbolizes (sembliedCCME WATER QUALITY INDICES version 1.00) is depended of an equation via British- -Columbia, Ministry-of-Environments also modification via the Alberta-Environment. The WQI inccluded 3factors: the scopes (F1) was the No.of variables donot meeting water-quality objectives. The frequencies (F2) is the No.of times these-objectives arenot-met as well as amplitude named as F3 the-amounts via That theobjectives werenot mett. The WQI produces as the number between 0 as polluted water while 100 as excellent Hommadi, A H et al.,2020 water quality as shown in Table.6.

5.5.1 Estimation of the C WQI

The estimation of scopes-F1 and frequencies-F2 and amplitude-F3. F1 represents the dividing the elements that are doing not meeting ofobjectives during least-once through the seasontime as failedd-variables calculated by equation (7):

$$\text{F1}=\left(\frac{\text{No.of failed.variables}}{\text{Summationof No.variables}}\right)*100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.(7)$$

$$\text{F2}=\frac{No.of\ \ failed.tests}{Summation\ \ No.of\ \ tests})*100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.\ldots\ldots(8)$$

$$F3\ \ is\ \ estimated\ \ by\ \ (3)\ \ steps.$$

(1) $Excursion$

$$Excursion\ =\frac{Failed.tests.value\ \ i}{Objective\ \ i})-1\ldots\ldots\ldots..\ldots\ldots\ldots.(9)\ \ Or$$

$$Excursion\ =\frac{Objective\ \ i}{Failed.test.value})-1\ldots\ldots\ldots..\ldots\ldots\ldots.(10)$$

(2) $Normalized\ \ sum\ \ of\ \ excursions\ \ (nse), nse\ =$

$$\left(\frac{\sum_{i=1}^{n} Nexcurasion\ \ i}{total\ \ number\ \ of\ \ tests}\right)\ldots..\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.(11)$$

$$F3\ =\left(\frac{nse}{0.01\ \ nse+0.01}\right)\ldots..\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.(12)$$

$$WQI\ \ equal\ \ to\ \ the\ \ square\ \ of\ \ three\ \ by\ \ equation\ \ (13)$$

$$CCME\ \ WQI\ =\ 100-\left(\frac{\sqrt{F1^2+F2^2+F3^2}}{1.732}\right)\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.(13)$$

Table (6):- shows the CCMEWQI categorization-schema+

Rank	WQI value
Excellent.	95.0-100.0
Good.	80.0-94.0
Fair.	65.0-79.0
Marginal.	45.0-64.0
Poor.	0.0-44.0

+ Canadian council in ministers of the-environmental-2001

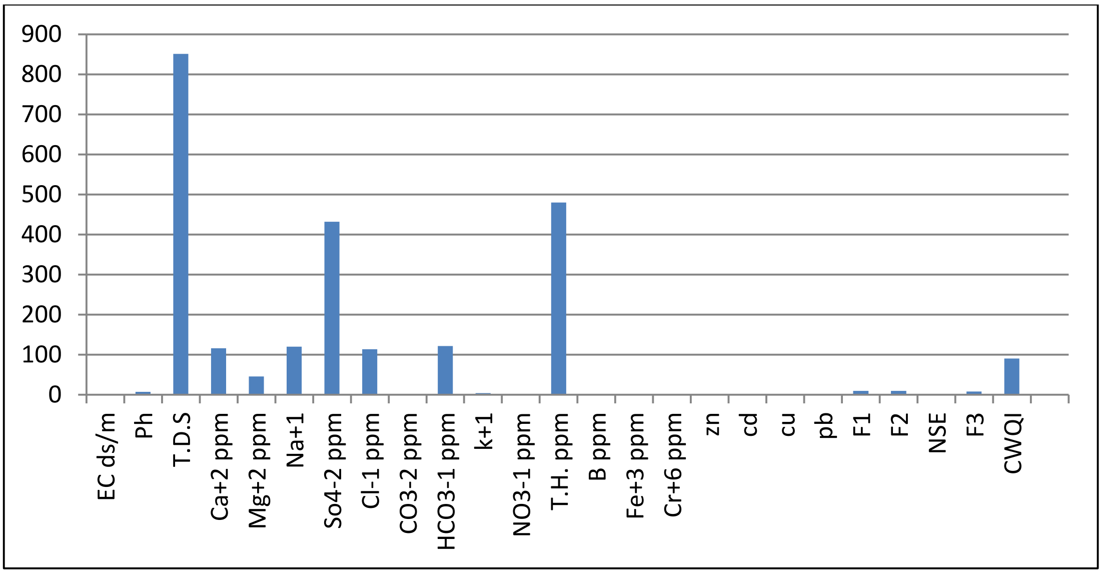


Fig.(10):-Concentration value at parameters and Canadian-water-quality indices

Via sampels-coolection and checking (testing) of the irrigation water site also evaluation the water testing via the CWQ indices. This evaluating of stream (river) water is good evaluation that it give ninty (90) which corresponds to an evaluation from the standard table is-excellent with-suitable to cultivation crops. As showing in table.7 and fig. 10

Table.(7-:) watering sources, F.1,F.2,NSE.,F.3 and CandianWQI

Location	F.1	F.2	NSE.	F.3	CandianWQI	Descriptions
Up stream of Al-Hindiya barrage	10.01	10.01	0.091	8.09	90.1	Excellents

5. CONCLUSIONS

the use of sheet as SWRT under croproot-zone in melon which was assist on saving the cropwater and nutrientthat putting of crops during the growth season and helps on reducing the number of water irrigation and quantity of applied water, resulting maximum-cropyield and water utilize-efficiency as well as evaluating work by the econamicwater productivity; conserving irigationwater in treatmentpolyethelineplot A was 19.6 % comparing withs treatmentplot B. Furthermore No. of watering was decreased of the poletheline treatmentplot A via 11 percent. The cropyield in polyetheline treatmentplot A was higher than of treatmentplot B via 3.92 percent. In addition to, WUE in polyetheline treatmentplot A was higher than in treatmentplot B via 22.62 percent. water-productivity values (WP) in poletheline treatmentplot A was higher than-in treatmentplot B by 20.65 percent. This value of cropyield raising as ell as the maximum price sale of melon crops. This increasing will give maximum values of the net-return, in addition to minimum quantity of the-supplied water can be beneficial to the farmer as long as it increases income and utility.This technology which names SWRT poletheline membranssheet Subsurface soil had the benefit of providing water, fertilizers and applied nutrients. SWRT method will gave beneficial oflight(sand)texture-soils. The deserts region could be convert to freegreen field. From result in above we obtain on more cropyiel and less water losse and cost was well as increase in watersaving and farmers income. This technology assist saving water and increase productivity through drought time because decreasing rain fall and snow and increasing evaporation and transpiration due to increasing temperature and radiation causes decreasing water as well as reduction of water from nighbours country.

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