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# EFFECT OF CULTIVATION MEDIA, IRRIGATION WATER SOURCES AND ORGANIC MANURE ON SOME WATER RELATIONS AND SOIL SALINITY UNDER PROTECTED GREENHOUSES

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## ABSTRACT

This investigation was conducted in plastic greenhouses at Sakha Agricultural Research Station to study the effect of cultivation media, irrigation water sources and organic manure levels on some water relations, soil salinity and total income under protected greenhouses condition .Split-split plot design with four replicates was used.
**The obtained results could be summarized as follows:**

1- The highest amount of water applied to cucumber and tomato crops were recorded with rice straw bales irrigated by fresh water, while the lowest values were recorded with clay soil irrigated by well water.
2- The highest irrigation water and water use efficiencies were achieved with rice straw bales for cucumber or clay soil for tomato as cultivation media, which irrigated by fresh water and treated with the rate of 20 tons/fed organic manure.
3- Salinity levels were increased after harvesting of cucumber in the 1 st season with the all treatments especially that irrigated by well water and treated by high rates of organic manure under clay soil. On contrary, salinity levels were decreased with all treatments at the end of the second season (tomato) ,especially with rice straw bales treated by low rates of organic manure and irrigated by fresh water.
4- The total incomes that obtained from cucumber and tomato grown in clay soil irrigated by fresh water and treated by high rates of organic manure were higher than those obtained with rice straw bales irrigated by low quality water without application of organic manure.

## INTRODUCTION

The scarcity of irrigation water highlights the importance of optimizing its use. Protected culture reduces evapotranspiration and increases the water use efficiency, relative to open air cultivation. Increasing the water use efficiency relative to other conventional irrigation methods is one of the most relevant advantages of drip irrigation, if it is properly operated. Straw is a major output of the production of rice, wheat, cotton, faba bean and maize (approximately two-third of the weight of the whole plant). Although several alternatives exist for the beneficial use of straw, i.e., compost, animal feed, roofing material, practical boards, bedding material and media for cultivation in greenhouses ,it appears that a large volume of straw is considered as waste, since it is simply burnt in the field by the farmers.

Many researchers showed that the organic matter content of the Egyptian soils is very low (between 0.5 and 2%). It is well known that organic matter , particularly in clay soil improves the soil structure , increases water and fertilizer retention capacity at the root zone , increases the microbial activity of the soil , in addition to releasing useful plant nutrients .The cultivated area occupied by rice crop in Kafr El - Shiekh Governorate is about 420,000 fed. in 2006 season, produced about million ton rice straw. The farmers burn the rice waste, this lead to environmental pollution. To overcome this problem, the rice straw bales can be used as a media to cultivate vegetables. Diver (2000).

Moreover, most soils at North Delta are salt affected soils and suffering from the shortage of fresh water; consequently it is not suitable for vegetables crops production (Ayers and Westcott,1985). Abdalla *et al* (1992) reported that increasing salinity levels progressively decreased all growth parameters.

Growth of cucumber seedlings was generally reduced by increasing salinity. Shoot and root dry weights were increased with decreasing Na: Ca ratio at 4.0 mg salts/ $m^3$ (Al Harbi, 1994). Applying saline water continuously for irrigation through surface drip irrigation system results in salt accumulation close to the soil surface. This process might inhibit water and nutrient uptake and affecting the crop growth and yield (Hanson, 1995). Abo Soliman *et al* (2002) found that the relative yield of tomato was reduced from 29.6 to 75.96 % with increasing water salinity level from 2 to 14 dS/m .Increasing salinity affects growth mainly by reduction the plant ability to absorb water (Hill and Richard, 1999). Tallat *et al*, (2002) revealed that drip irrigation caused a considerable increase of salinity build – up followed by subsurface irrigation. Also, it was observed that water application display a remarkable increase of soil salinity build-up with saline water more than with cyclic low salt concentration water. Al-Jaloud *et al* (2000) found that cucumber and tomato need about 7000 $m^3$ water/ha under greenhouses using drip irrigation lowering irrigation sustained production and increased water use efficiency without significantly decreasing the growth and yield components of cucumber and tomato. El- Jovicich *et al* (2007) found that the fruit yields, fruit quality and crop water and nutrient use efficiencies of cucumber resulted with greenhouse were greater than those with field production system. With a closed irrigation system in the greenhouse, total water requirements for tomato crop grown in the field for 90 to 120 days are 400 to 600 mm depending on the climate condition (Doorenbos and Kassam ,1986).

The main objective of this study was to investigate the effect of different cultivation medias, irrigation water sources and organic manure levels on some water relations, soil salinity and total income under protected greenhouses condition.

## MATERIALS AND METHODS

This investigation was conducted in the protected greenhouses at Sakha Agricultural Research Station, Kafr Elshiekh Governorate. These greenhouses are belonging to Soil Improvement and Conservation Research Department, Soil, Water and Environment Research Institute. The experiment started in summer growing season 2008 with cucumber seedlings (variety Gianco RZ) which transplanted on May ,8th , 2008 and harvested on July , 14th , 2008 followed by tomato (variety Lora ) which transplanted in the beginning of November , 2008 and harvested on June , 8th, 2009. The research experiments were carried out in four protected greenhouses with dimension 4-5 m width and 19- 24 m length. Split – split plot design with four replicates is used.

**The main treatments were devoted to cultivation media:**

1 Rice straw bales.
2 Ordinary clay soil ( in buried cement lysimeters)

**Sub –treatments were subjected to different water sources.**

1 Fresh water ( 0.4 dS/ m )
2 Well water (1.51 dS / m).
3 Blended fresh water with well water (0 .99 dS / m at ratio of 1:1).

**Sub –sub treatments were assigned to organic manure levels**

- Zero (control).
- 5 ton / fed.
- 10 ton / fed.
- 15 ton / fed.
- 20 ton / fed.

Soil samples were taken at 0-15 and 15-30 cm depths for some chemical analysis. Also, samples were taken from rice straw bales and farmyard manure to determine N, P, K and organic carbon content ( to calculate C/N ratio ) as shown in Tables (1 and 2).

**Table (1): Soil chemical analysis before planting cucumber in summer 2008.**

| Soil depth ( cm ) | EC dS /m at 25$^{0C}$ | Cations (meq /L) | | | | Anions (meq / L) | | | | SAR |
|---|---|---|---|---|---|---|---|---|---|---|
| | | $Na^+$ | $K^+$ | $Ca^{++}$ | $Mg^{++}$ | $Co3^{--}$ | $HCO3^-$ | $CL^-$ | $SO4^=$ | |
| 0 -15 | 2.54 | 17.0 | 0.3 | 4.0 | 5.5 | 0.0 | 4.5 | 11.9 | 10.4 | 7.8 |
| 15 -30 | 2.74 | 18.6 | 0.3 | 4.4 | 6.0 | 0.0 | 5.0 | 13.0 | 11.3 | 8.16 |

**Table (2): C/N ratio for farmyard manure and rice straw bales.**

| Elements | N % | P ( ppm ) | K % | C % | C / N ratio |
|---|---|---|---|---|---|
| Farmyard manure | 0.62 | 3.91 | 1.4 | 38.26 | 61.71 |
| Rice straw | 0.31 | 2.95 | 1.2 | 29.1 | 93.87 |

**Table (3): Climatological data for cucumber growing season (from May to July, 2008).**

| Month | Air temp. c$^0$ | | | Relative humidity% | Wind speed m/sec at 2 m height | Rain mm | Pan Evaporation mm/day |
|---|---|---|---|---|---|---|---|
| | Max. | Min. | Mean | | | | |
| May | 30 | 10.83 | 20.42 | 58.33 | 1.25 | 0 | 7.137 |
| June | 33.13 | 14.90 | 24.02 | 66.42 | 1.23 | 0 | 7.333 |
| July | 32.97 | 16.20 | 24.58 | 69.57 | 1.02 | 0 | 7.01 |

**Table (4): Climatological data for tomato growing season (from Nov. 2008 to June, 2009).**

| Month | Air temp. C° | | | Relative humidity % | Wind speed m/sec at 2 m height | Rain mm | Pan Evaporation mm/day |
|---|---|---|---|---|---|---|---|
| | Max. | Min. | mean | | | | |
| Nov. 2008 | 25.11 | 11.09 | 18.1 | 64.62 | 1.26 | 4.19 | 3.01 |
| Dec. 2008 | 19.76 | 7.9 | 13.83 | 65.13 | 1.29 | 5.4 | 2.35 |
| Jan. 2009 | 17.72 | 6.74 | 12.23 | 67.69 | 1.42 | 5.64 | 2.17 |
| Feb. 2009 | 18.22 | 6.37 | 12.3 | 68.27 | 1.52 | 6.1 | 2.68 |
| March | 20.17 | 7.86 | 14.02 | 65.22 | 1.55 | 3.31 | 3.59 |
| April | 25.15 | 10.51 | 17.83 | 63.08 | 1.59 | 0.54 | 5.32 |
| May | 28.9 | 13.69 | 21.30 | 58.53 | 1.79 | 0.24 | 7.25 |
| June | 31.88 | 17.77 | 24.82 | 63.56 | 1.93 | 0.003 | 9.39 |

Preliminary preparation of rice straw bales inside greenhouses was performed before transplanting of cucumber as follows:

1. Rice straw bales were arranged in two rows (65 cm. spacing) for each greenhouse. Each greenhouse contains two rows of buried lysimeters (65 cm length * 65 cm width).
2. Drip irrigation network is installed on rice straw bales and buried lysimeters (two laterals per row) with drippers at 50 cm spacing. The rice straw bales were moisten by irrigation water through drip irrigation system.
3. Rice straw bales were treated two times by pigeon manure (25 kg pigeon manure soaked in 200 liter fresh water for 48 hours and filtered).
4. Each plastic houses was sterilized by parasitcide solution (at rate of 2ml per liter water).
5. Fertilization (N, P and K) were applied in the form of ammonium nitrate 33%, super phosphate 15.5 % and potassium sulphate 48%, respectively. All agronomic practices were done as the recommendation in the area.

**Parameters studied:**

- Crop evapotranspiration: was calculated using FAO Penman Monteith equation as described in Irrigation and Drainage Technical Paper No. 56 by Richard, *et al* (1988).
- Water use efficiency: was computed by dividing the fresh yield of cucumber or tomato on actual evapotranspiration value expressed as cubic meter of water (Abdel-Rasool *et al*, 1971).
- Irrigation water use efficiency: was computed by dividing the fresh yield of cucumber or tomato on amount of water applied expressed as cubic meters of water (Michael, 1978).
- Amounts of irrigation water applied for each treatment was estimated based on dripper discharge ($m^3$/hr) and working time (hr).
- Electrical conductivity (ECe) was measured by electrical conductivity meter as dS/m at $25^0$C in soil paste extract after harvesting of cucumber and tomato according to Jackson (1967).
- Economic analysis: An economic analysis was performed based on production data for cucumber and tomato. Fixed and variable costs and net profit were estimated for each treatment.

# RSULTS AND DISCUSSION

**Actual evapotranspiration**:

Potential and actual evapotranspiration for cucumber and tomato were calculated by FAO Penman Monteith from the climatological data as shown in Tables (5 and 6).

**Table (5): Potential and actual evapotranspiration for cucumber growing season.**

| Months | Period | Potential evapotranspiration cm/period | | Crop coefficient Kc | Actual evapo-transpiration cm |
|---|---|---|---|---|---|
| | | cm/day | cm/period | | |
| May 2008 | 8 – 31/5 | 0.56 | 13.44 | 0.6 | 8.06 |
| June 2008 | 1- 30/6 | 0.63 | 18.9 | 1.0 | 18.9 |
| July 2008 | 1 – 13/7 | 0.55 | 7.15 | 0.75 | 5.36 |
| Total | | | | | 32.32 |

**Table (6): potential and actual evapotranspiration for tomato growing season.**

| Month | Period | Potential evapotranspiration cm/period | | Crop-coeff . Kc | Actual evapotranspiration cm |
|---|---|---|---|---|---|
| | | Cm/day | Cm/period | | |
| Nov. 2008 | 9 – 30/11/08 | 0.295 | 6.49 | 0.4 | 2.6 |
| Dec. 2008 | 1 – 31/12/08 | 0.23 | 7.13 | 0.65 | 4.63 |
| Jan. | 1 – 31/1/2009 | 0.199 | 6.17 | 0.9 | 5.55 |
| Feb. | 1– 28/2/09 | 0.24 | 6.72 | 1.2 | 8.06 |
| March | 1– 31/3/09 | 0.325 | 10.08 | 1.2 | 12.1 |
| April | 1– 30/4/09 | 0.443 | 13.29 | 1.0 | 13.29 |
| May | 1 – 31/5/09 | 0.559 | 17.33 | 0.95 | 16.46 |
| June | 1 – 8/6/09 | 0.628 | 5.02 | 0.85 | 4.27 |
| Total | | | | | 66.96 |

**Amount of irrigation water applied:**

Data in Tables (7 and 8) show that excess of irrigation water is attained with rice straw bales as cultivation media for cucumber and tomato which irrigated by fresh water. The lowest amount of irrigation water for cucumber and tomato crops are found with clay soil as cultivation media which irrigated by well water. The results also show that using of well or blended water for irrigating cucumber grown on straw bales can save about 20% and 7.43 % of water applied, respectively compared to irrigation by fresh water. While with clay soil about 20.5 and 11.8 %, can be saved with stated water types, respectively. For tomato crop, the water saving was about 4.52 and 3.89 % under rice straw bales and 7.72% and 3.17% under clay soil irrigated by well and blended water , respectively compared to fresh water.

**Irrigation water and water use efficiencies:**

Irrigation water and water use efficiencies were determined for different treatments and presented in Tables (7 and 8).

It could be noticed that the highest values of both efficiencies for cucumber are achieved from the interaction between rice straw bales, irrigation by fresh water and application of organic manure at the rate of 20 tons /fed. While under cultivation of tomato crop, the highest values of water efficiencies are obtained from the combination between ordinary clay soil as cultivation media, irrigation by fresh water and adding organic manure at the rate of 20 tons /fed.. On the other hand, the lowest values of water production function with cucumber are produced from the interaction between ordinary clay soils, irrigation with well water without application of organic manure. While under cultivation of tomato, the lowest values of water efficiencies are recorded from the combination between rice straw bales, irrigation by well water without application of organic manure**.**

**Table (7): Irrigation water use and water use efficiencies (kg/m$^3$ ) for cucumber as affected by cultivation media, water sources and organic manure levels under protected greenhouses during summer season( 2008)**

| Cultivation media | Water sources | Organic manure levels (ton/fed) | Cucumber yield kg/fed. | Actual evapo-transpiration m$^3$/fed. | Amount of water m$^3$/fed | Water use efficiency kg/ m$^3$ | Irrigation water use efficiency kg/ m$^3$ |
|---|---|---|---|---|---|---|---|
| Rice straw bales | Fresh water | 0 | 14028 | 1357.4 | 2100 | 10.33 | 6.68 |
| | | 5 | 20664 | 1357.4 | 2100 | 15.22 | 9.84 |
| | | 10 | 22428 | 1357.4 | 2100 | 16.52 | 10.68 |
| | | 15 | 25662 | 1357.4 | 2100 | 18.91 | 12.22 |
| | | 20 | 30576 | 1357.4 | 2100 | 22.53 | 14.56 |
| | Well water | 0 | 8988 | 1357.4 | 1680 | 6.62 | 5.35 |
| | | 5 | 10668 | 1357.4 | 1680 | 7.86 | 6.35 |
| | | 10 | 12600 | 1357.4 | 1680 | 9.28 | 7.5 |
| | | 15 | 14448 | 1357.4 | 1680 | 10.64 | 8.6 |
| | | 20 | 18354 | 1357.4 | 1680 | 13.52 | 10.93 |
| | Blended water Fresh: well (1:1) | 0 | 14028 | 1357.4 | 1944 | 10.33 | 7.22 |
| | | 5 | 16464 | 1357.4 | 1944 | 12.13 | 8.47 |
| | | 10 | 22092 | 1357.4 | 1944 | 16.28 | 11.36 |
| | | 15 | 23352 | 1357.4 | 1944 | 17.2 | 12.01 |
| | | 20 | 23394 | 1357.4 | 1944 | 17.23 | 12.03 |
| Clay soil | Tap water | 0 | 14742 | 1357.4 | 1848 | 10.86 | 7.98 |
| | | 5 | 19026 | 1357.4 | 1848 | 14.02 | 10.3 |
| | | 10 | 22092 | 1357.4 | 1848 | 16.28 | 11.95 |
| | | 15 | 23352 | 1357.4 | 1848 | 17.2 | 12.64 |
| | | 20 | 24486 | 1357.4 | 1848 | 18.04 | 13.25 |
| | Well water | 0 | 6762 | 1357.4 | 1470 | 4.98 | 4.6 |
| | | 5 | 7812 | 1357.4 | 1470 | 5.76 | 5.31 |
| | | 10 | 10500 | 1357.4 | 1470 | 7.74 | 7.14 |
| | | 15 | 10962 | 1357.4 | 1470 | 8.08 | 7.46 |
| | | 20 | 12516 | 1357.4 | 1470 | 9.22 | 8.51 |
| | Blended water Fresh: well (1:1) | 0 | 8610 | 1357.4 | 1630 | 6.34 | 5.28 |
| | | 5 | 10458 | 1357.4 | 1630 | 7.7 | 6.42 |
| | | 10 | 11634 | 1357.4 | 1630 | 8.57 | 7.14 |
| | | 15 | 12852 | 1357.4 | 1630 | 9.47 | 7.88 |
| | | 20 | 16380 | 1357.4 | 1630 | 12.07 | 10.5 |

**Table (8): irrigation water use and water use efficiencies (kg/ m$^3$) for tomato as affected by cultivation media, water sources and organic manure levels under protected greenhouses during winter season (08/09).**

| Cultivation media | Water sources | Organic manure levels (ton/fed) | Tomato yield kg/fed. | Actual evapo-transpiration m$^3$/fed. | Amount of water m$^3$/fed. | Water use efficiency kg/m$^3$ | Irrigation water use efficiency Kg/m$^3$ |
|---|---|---|---|---|---|---|---|
| Rice straw bales | Fresh water | 0 | 92190 | 2919.1 | 3654 | 31.58 | 25.23 |
| | | 5 | 96138 | 2919.1 | 3654 | 32.93 | 26.31 |
| | | 10 | 102984 | 2919.1 | 3654 | 35.28 | 28.18 |
| | | 15 | 107268 | 2919.1 | 3654 | 36.75 | 29.36 |
| | | 20 | 117936 | 2919.1 | 3654 | 40.4 | 32.28 |
| | Well water | 0 | 65856 | 2919.1 | 3489 | 22.56 | 18.87 |
| | | 5 | 68628 | 2919.1 | 3489 | 23.51 | 19.67 |
| | | 10 | 70308 | 2919.1 | 3489 | 24.09 | 20.15 |
| | | 15 | 73332 | 2919.1 | 3489 | 25.12 | 21.02 |
| | | 20 | 76356 | 2919.1 | 3489 | 26.16 | 21.88 |
| | Blended water Fresh: well (1:1) | 0 | 78120 | 2919.1 | 3512 | 26.76 | 22.24 |
| | | 5 | 82740 | 2919.1 | 3512 | 28.34 | 23.56 |
| | | 10 | 86520 | 2919.1 | 3512 | 29.64 | 24.64 |
| | | 15 | 96180 | 2919.1 | 3512 | 32.95 | 72.39 |
| | | 20 | 104160 | 2919.1 | 3512 | 35.68 | 29.66 |
| Clay soil | Fresh water | 0 | 85512 | 2919.1 | 3470 | 29.29 | 24.64 |
| | | 5 | 87528 | 2919.1 | 3470 | 29.98 | 25.22 |
| | | 10 | 94332 | 2919.1 | 3470 | 31.32 | 72.19 |
| | | 15 | 113904 | 2919.1 | 3470 | 39.02 | 32.83 |
| | | 20 | 125538 | 2919.1 | 3470 | 43.01 | 36.18 |
| | Well water | 0 | 82992 | 2919.1 | 3202 | 28.43 | 25.91 |
| | | 5 | 85386 | 2919.1 | 3202 | 29.25 | 26.67 |
| | | 10 | 92526 | 2919.1 | 3202 | 31.70 | 28.9 |
| | | 15 | 102060 | 2919.1 | 3202 | 34.96 | 31.87 |
| | | 20 | 109158 | 2919.1 | 3202 | 37.39 | 34.1 |
| | Blended water Fresh: well (1:1) | 0 | 84252 | 2919.1 | 3360 | 28.86 | 25.08 |
| | | 5 | 86436 | 2919.1 | 3360 | 29.61 | 25.73 |
| | | 10 | 93282 | 2919.1 | 3360 | 31.96 | 27.76 |
| | | 15 | 107982 | 2919.1 | 3360 | 36.99 | 32.14 |
| | | 20 | 117348 | 2919.1 | 3360 | 40.2 | 34.93 |

The highest values of irrigation and water use efficiencies may be related to the high yield obtained from the interaction between these treatments**.** AL-Jaloud *et al*. (2000) found that lowering irrigation sustained production and increased water use efficiency without significantly decreasing the growth and yield components of cucumber and tomato.

**Salinity and sodicity:**

The salinity and sodicity of rice straw bales and ordinary clay soil after harvesting of cucumber and tomato are presented in Table (9).

The salinity and sodicity values of the cultivation media are increased after harvesting of cucumber especially with clay media. On the other hand, after harvesting of tomato grown on rice straw bales, the salinity values are decreased with all treatments except with that treated with high rates of farmyard manure, and irrigated by well or blended water.

It is clear that as organic manure level increases from 10 to 15 or 20 tons /fed. the salinity level increased cultivation media. The increase in salinity may be due to that the salt content in the organic manure and the ability of organic manure to retain water containing salts. Also, the cultivation on ordinary clay soil tends to accumulate more salts than that with rice straw bales because rice straw bales received irrigation water more than ordinary clay soil.

**Table (9): EC and SAR of soil as affected by cultivation media, water sources and organic manure levels under protected greenhouses after harvesting of cucumber and tomato**

| Cultivation media | Treatments | | After harvesting of cucumber | | After harvesting of tomato | |
|---|---|---|---|---|---|---|
| | Water sources | Organic manure (ton/fed.) | EC dS/m | SAR | EC dS/m | SAR |
| Rice straw bales | | | Before experiment. | | 2.54 | 7.85 |
| | Fresh water | 5 | 3.11 | 8.7 | 1.68 | 6.39 |
| | | 10 | 3.87 | 9.7 | 1.71 | 6.45 |
| | | 15 | 3.88 | 9.72 | 1.76 | 6.54 |
| | | 20 | 5.0 | 11.03 | 1.89 | 6.78 |
| | Well water | 5 | 4.97 | 11.0 | 1.93 | 6.85 |
| | | 10 | 5.14 | 11.18 | 1.97 | 6.92 |
| | | 15 | 6.03 | 12.11 | 3.23 | 8.87 |
| | | 20 | 9.26 | 15.01 | 4.76 | 10.53 |
| | Blended Fresh: well (1:1) water | 5 | 4.46 | 10.45 | 1.73 | 6.49 |
| | | 10 | 4.92 | 10.94 | 1.85 | 6.71 |
| | | 15 | 5.37 | 11.43 | 2.25 | 7.4 |
| | | 20 | 6.81 | 12.87 | 3.01 | 8.56 |
| Clay soil | Fresh water | 5 | 6.81 | 12.87 | 1.77 | 6.56 |
| | | 10 | 7.98 | 13.94 | 1.82 | 6.66 |
| | | 15 | 8.89 | 14.71 | 2.17 | 7.27 |
| | | 20 | 9.01 | 14.81 | 2.35 | 7.56 |
| | Well water | 5 | 7.54 | 13.55 | 2.15 | 7.23 |
| | | 10 | 10.92 | 16.3 | 2.63 | 8.0 |
| | | 15 | 12.53 | 17.46 | 4.77 | 10.75 |
| | | 20 | 16.93 | 20.3 | 4.84 | 10.77 |
| | Blended water Fresh: well (1:1) | 5 | 6.99 | 13.4 | 2.41 | 7.66 |
| | | 10 | 8.75 | 14.59 | 3.19 | 8.81 |
| | | 15 | 10.24 | 15.92 | 4.19 | 10.10 |
| | | 20 | 11.73 | 16.9 | 4.74 | 1`0.74 |

**Economic analysis:**

In evaluating different cultivation medias, water sources and organic manure levels, it is important to compare costs and net profit. Table 10 and 11 provides a listing of the total income, total cost and net profit for each treatment under. cultivation of cucumber and tomato.

**Table (10): Values of Cucumber productivity (kg/m2), total income, total cost and net profit (LE/m$^2$)**

| Cultivation media | Water resources | Organic manure rates | productivity (Kg/ m$^2$) | Total income (LE/ m$^2$) | Costs (LE) | | | Net profit (LE/m$^2$) |
|---|---|---|---|---|---|---|---|---|
| | | | | | Variable | Fixed. | Total | |
| Rice straw bales | Fresh water | 0 | 3.34 | 6.01 | 3 | 2.77 | 5.77 | 0.24 |
| | | 5 | 4.92 | 8.86 | 3 | 2.77 | 5.77 | 3.09 |
| | | 10 | 5.34 | 9.61 | 3 | 2.77 | 5.77 | 3.84 |
| | | 15 | 6.11 | 11.00 | 3 | 2.77 | 5.77 | 5.23 |
| | | 20 | 7.28 | 13.10 | 3 | 2.77 | 5.77 | 7.33 |
| | Well water | 0 | 2.14 | 3.85 | 3 | 2.77 | 5.77 | -1.92 |
| | | 5 | 2.54 | 4.57 | 3 | 2.77 | 5.77 | -1.20 |
| | | 10 | 3.00 | 5.40 | 3 | 2.77 | 5.77 | -0.37 |
| | | 15 | 3.44 | 6.19 | 3 | 2.77 | 5.77 | 0.42 |
| | | 20 | 4.37 | 7.87 | 3 | 2.77 | 5.77 | 2.10 |
| | Blended water b | 0 | 3.34 | 6.01 | 3 | 2.77 | 5.77 | 0.24 |
| | | 5 | 3.92 | 7.06 | 3 | 2.77 | 5.77 | 1.29 |
| | | 10 | 5.26 | 9.47 | 3 | 2.77 | 5.77 | 3.70 |
| | | 15 | 5.56 | 10.01 | 3 | 2.77 | 5.77 | 4.24 |
| | | 20 | 5.57 | 10.03 | 3 | 2.77 | 5.77 | 4.26 |
| Clay soil | Fresh water | 0 | 3.51 | 6.32 | 3 | 1.38 | 4.38 | 1.94 |
| | | 5 | 4.53 | 8.15 | 3 | 1.38 | 4.38 | 3.77 |
| | | 10 | 5.26 | 9.47 | 3 | 1.38 | 4.38 | 5.09 |
| | | 15 | 5.56 | 10.01 | 3 | 1.38 | 4.38 | 5.63 |
| | | 20 | 5.83 | 10.49 | 3 | 1.38 | 4.38 | 6.11 |
| | Well water | 0 | 1.61 | 2.90 | 3 | 1.38 | 4.38 | -1.48 |
| | | 5 | 1.86 | 3.35 | 3 | 1.38 | 4.38 | -1.03 |
| | | 10 | 2.5 | 4.50 | 3 | 1.38 | 4.38 | 0.12 |
| | | 15 | 2.61 | 4.70 | 3 | 1.38 | 4.38 | 0.32 |
| | | 20 | 2.98 | 5.36 | 3 | 1.38 | 4.38 | 0.98 |
| | Blended water b | 0 | 2.05 | 3.69 | 3 | 1.38 | 4.38 | -0.69 |
| | | 5 | 2.49 | 4.48 | 3 | 1.38 | 4.38 | 0.10 |
| | | 10 | 2.77 | 4.99 | 3 | 1.38 | 4.38 | 0.61 |
| | | 15 | 3.06 | 5.51 | 3 | 1.38 | 4.38 | 1.13 |
| | | 20 | 3.9 | 7.02 | 3 | 1.38 | 4.38 | 2.64 |

Total income of cucumber is based on the productivity of fresh cucumber in kg/m$^2$, while the total income of tomato is based on the productivity of fresh tomato plus the income returned from compost produced from decomposition of rice straw bales after two growing seasons.

Fixed costs included infrastructure of greenhouses such as iron skelton, drip irrigation network and plastic sheets while variable costs included labors, fertilizers, rice straw bales and seedlings of cucumber and tomato.

Data indicated that as the rate of organic manure increased up to 15 or 20 tons / fed. the total income and net profit were increased. The highest values of total income and net profit for cucumber are realized with application of organic manure at rate of 20 tons / fed. When both cultivation medias irrigated by fresh water followed by irrigation with blended water especially with rice straw bales as cultivation media.

**Table (11): Values of tomato productivity (kg/m²), total income, total cost and net profit (LE/ m²)**

| Cultiva-tion media | Water sources | Organic manure rates (ton/fed) | Productivity (Kg/m²) | | Total income (LE/m²) | costs | | | Net profit (LE/m²) |
|---|---|---|---|---|---|---|---|---|---|
| | | | Yield | Compost | | Variable | Fixed. | Total. | |
| Rice straw bales | Fresh water | 0 | 21.95 | 0.00 | 43.9 | 2.4 | 2.77 | 5.17 | 38.73 |
| | | 5 | 22.89 | 96.63 | 48.57 | 2.4 | 2.77 | 5.17 | 43.40 |
| | | 10 | 24.52 | 98.80 | 51.89 | 2.4 | 2.77 | 5.17 | 46.72 |
| | | 15 | 25.54 | 111.8 | 54.31 | 2.4 | 2.77 | 5.17 | 49.14 |
| | | 20 | 28.08 | 118.1 | 59.57 | 2.4 | 2.77 | 5.17 | 54.40 |
| | Well water | 0 | 15.68 | 0.00 | 31.36 | 2.4 | 2.77 | 5.17 | 26.19 |
| | | 5 | 16.34 | 100.9 | 35.60 | 2.4 | 2.77 | 5.17 | 30.43 |
| | | 10 | 16.76 | 107.4 | 36.61 | 2.4 | 2.77 | 5.17 | 31.44 |
| | | 15 | 17.46 | 109.5 | 38.08 | 2.4 | 2.77 | 5.17 | 32.91 |
| | | 20 | 18.18 | 115.96 | 39.71 | 2.4 | 2.77 | 5.17 | 34.54 |
| | Blended water | 0 | 18.6 | 0.00 | 37.2 | 2.4 | 2.77 | 5.17 | 32.03 |
| | | 5 | 19.7 | 79.33 | 42.01 | 2.4 | 2.77 | 5.17 | 36.84 |
| | | 10 | 20.6 | 95.20 | 44.33 | 2.4 | 2.77 | 5.17 | 39.16 |
| | | 15 | 22.9 | 111.1 | 49.45 | 2.4 | 2.77 | 5.17 | 44.28 |
| | | 20 | 24.8 | 126.9 | 53.77 | 2.4 | 2.77 | 5.17 | 48.60 |
| Clay soil | Fresh water | 0 | 20.36 | 0.00 | 40.72 | 2.4 | 1.38 | 3.78 | 36.94 |
| | | 5 | 20.84 | 0.00 | 41.68 | 2.4 | 1.38 | 3.78 | 37.90 |
| | | 10 | 22.46 | 0.00 | 44.92 | 2.4 | 1.38 | 3.78 | 41.14 |
| | | 15 | 27.12 | 0.00 | 54.24 | 2.4 | 1.38 | 3.78 | 50.46 |
| | | 20 | 29.89 | 0.00 | 59.78 | 2.4 | 1.38 | 3.78 | 56.00 |
| | Well water | 0 | 19.76 | 0.00 | 39.52 | 2.4 | 1.38 | 3.78 | 35.74 |
| | | 5 | 20.33 | 0.00 | 40.66 | 2.4 | 1.38 | 3.78 | 36.88 |
| | | 10 | 22.03 | 0.00 | 44.06 | 2.4 | 1.38 | 3.78 | 40.28 |
| | | 15 | 24.3 | 0.00 | 48.60 | 2.4 | 1.38 | 3.78 | 44.82 |
| | | 20 | 25.99 | 0.00 | 51.98 | 2.4 | 1.38 | 3.78 | 48.20 |
| | Blended water | 0 | 20.06 | 0.00 | 40.12 | 2.4 | 1.38 | 3.78 | 36.34 |
| | | 5 | 20.58 | 0.00 | 41.16 | 2.4 | 1.38 | 3.78 | 37.38 |
| | | 10 | 22.21 | 0.00 | 44.42 | 2.4 | 1.38 | 3.78 | 40.64 |
| | | 15 | 25.71 | 0.00 | 51.42 | 2.4 | 1.38 | 3.78 | 47.64 |
| | | 20 | 27.94 | 0.00 | 55.88 | 2.4 | 1.38 | 3.78 | 52.10 |

*** The price of one kg of compost is 0.2 LE**

It is clear that a negative value for net profit is recorded when cucumber plants grown on rice straw bales or ordinary clay soil and irrigated by well water under all application rates of organic manure except 20 tons / fed.The occurrence of negative values for net profit may be due to that the cucumber plants are sensitive to salinity of well water.

This finding is in agreement with those obtained by Al-Harbi, (1994) who stated that the growth of cucumber seedlings was generally reduced by increasing salinity. Also, Hanson, (1995)concluded that applying saline water continuously for irrigation through surface drip irrigation system results in salt accumulation close to the soil surface. This process might inhibit water and nutrient uptake and affecting the crop growth and yield.

For tomato crop, all values of net profit are positive with different treatments. The highest value of net profit was obtained with interaction between cultivation on ordinary clay soil, irrigation by fresh water and application of organic manure at 20 ton / fed. While the lowest value of net profit was obtained from combination between rice straw bales as cultivation media irrigated by well water without application of organic manure.

**Conclusion :**

It could be concluded that the rice straw bales irrigated by low quality water can be economically used for production of some vegetable crops without adverse effect on crop productivity and soil salinity content.

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## تأثير بيئات النمو ومصادر مياه الري والسماد العضوي على بعض العلاقات المائية وملوحة التربة مع الزراعة المحمية

**محمود محمد سعيد , جمال محمد الصناط , بهجت عبدا لقوى زامل و حسن على شمس الدين**
**معهد بحوث الأراضي والمياه والبيئة**

اجري هذا البحث في الصوب المحمية بمحطة البحوث الزراعية بسخا في الموسم الزراعي الصيفي 2008و في الموسم الزراعي الشتوي 2009/2008 لدراسة تأثير بيئات النمو المختلفة و مصادر المياه و مستويات التسميد العضوي على بعض العلاقات المائية و ملوحة التربة و العائد الكلي و صافي العائد تحت ظروف الصوب المحمية مع استخدم التصميم القطاعات المنشقة مرتين في أربعة مكررات

**وكانت أهم النتائج المتحصل عليها كما يلي:-**

1- تحققت اعلي القيم لمياه الري المضافة لمحصولي الخيار و الطماطم المنزرعة في بالات القش المروية بالماء العذب بينما كانت اقل كميات المياه المضافة في الأرض الطينية المروية بماء البئر.
2- تحققت اعلي كفاءات لكل من الماء المضاف و الماء الاستهلاكي مع بالات قش الأرز المنزرعة بمحصول الخيار أو في التربة الطينية المنزرعة بمحصول الطماطم و المروية بالماء العذب و المعاملة بالسماد البلدي بمعدل 20طن/فدان.
3- زادت مستويات الملوحة في كل من بالات قش الأرز و الأرض الطينية بعد حصاد الخيار في الموسم الأول مع كل المعاملات خصوصا المروية بماء بئر وعلى الجانب الآخر انخفضت مستويات الملوحة مع معظم المعاملات بعد حصاد محصول الطماطم( في الموسم الثاني) خصوصا مع الماء العذب و المعدل المنخفض من إضافة التسميد العضوي في بالات القش.
4- تحقق اعلي دخل لمحصول الخيار المنزرع في بالات القش والمروية بالماء العذب.بينما تحقق أعلى دخل لمحصول الطماطم في الأرض الطينية المروية بالماء العذب مع اعلي معدل إضافة من التسميد العضوي و كان اعلي من تلك المتحصل عليها في بالات القش المروية بماء البئر القليلة الصلاحية دون إضافة للسماد العضوي.

**قام بتحكيم البحث**

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