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Effect of Irrigation Levels and Some Soil Applied Herbicides on Weeds, Water Use efficiency and Productivity of garlic (*Allium sativum* L.)

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Abstract

Two field experiments were conducted during 2016/2017 and 2017/2018 winter seasons in clay soil at El-Kanater El-Khiria, Horticulture research station to study the effect of two irrigation water regimes *i.e.* 75 & 100 % of potential evapotranspiration (ETc) under six weed control treatments by Pendimethalin (Stomp extra 45.5% CS at the rate of 1.7 l/fedden), oxyfluorfen (Roal 24% EC at the rate of 750 cm^3/fed. and/ or supplemented with additional hand hoeing once and hand hoeing twice addition to unweeded check on weeds , garlic yield and their water relationship *i.e.* consumptive use (Cu) and water use efficiency (WUE).Experimental design was split plot where the two treatments of water regime were allocated in the main plots and weed control treatments in subplots in four replicates. The main findings show that the experimental field was infested by annual weeds for the unweeded check by 1.35 and 1.47 ton/feddan dry weight of weeds, exhibited yield loss of 16.1 and 15.1% of garlic yield per feddan than hand hoeing twice in both 2016 /2017 and 2017/2018 seasons, respectively.Also all various weed categories as well as various yield components and yield of garlic tended to increase significantly in both seasons with adding irrigation water by 100 % from potential evapotranspition (ETc) treatment, meanwhile, water use efficiency for irrigation treatments tended to increase by 75 % from potential evapotranspition (ETc) 19.9 and 25.2% of ETc in 2016 /2017 and 2017/2018 seasons, respectively, and economically feasible. The reduction in garlic yield under irrigation level by 75 % equal 7&4 % in 1st and 2nd seasons and can consider non mean full difference with saving irrigation water476 &579 cubic meter which equal two irrigation. While, water use efficiency for Stomp at 1.7 L/fed, Stomp + h. hoeing once, Roal at 075 L/fed, Roal+ h. hoeing once and h. hoeing twice tended to increase by 34.0 & 53.8 & 28.8 & 43.4 and 29.7%, respectively more than unweeded check in the first season and by 29.2 & 38.4 & 27.0 & 31.9 and 26.5%, respectively, more than unweeded check which attributed the reduction of weed competition for water consumption. All weed control treatments gave significant effect on controlling weeds and increased growth characteristics and bulb garlic yields. Stomp at 1.7 L/fed h plus hand hoeing once gave the highest increase in net income (LE) by 118.3 and 94.4% respectively, more than unweeded check. Regarding, the interaction between irrigation water levels and weed control treatments, there was a little significant effect with soil moisture 100 % and herbicide residue of Stomp and Roal herbicides which in weed control elements used in garlic bulb less than allowable level.

Keywords: garlic productivity, irrigation levels, soil applied herbicides, weeds and water use efficiency.

Introduction

Garlic is an important vegetables crop which is grown in all Governorates of Egypt with is cultivated area 207045 fedddan with producing about two million and seventy thousands ton with average yield of 9.9 ton/feddan. during 2016/2017 season. However, yield are generally low. Where weeds are among the major obstacles for improving yield productively. Garlic has long growing seasons stad rting from October until April (180 days approximately). This period is suitable for growing more than flush of weeds. For this reason weed control is considered as one of the major practices which increase production costs and consequently affect economically the final return of garlic production. Hand hoeing is still the main common method for controlling weeds in garlic under Egyptian conditions. Water, or the lack of it is the environmental factor most often limiting crop growth and yield, even in humid temperate regions **(Begg and Turner 1976).** The water use efficiency will depend not only on the transpiration efficiency of the leaves but also on the water loss from the soil and the optimization of yield per unit of water used is necessary **(Neil 1986).** Net irrigation water requirement is the quantity of water necessary for crop growth. It is expressed in millimeter /year or in m^3 /ha/year (1mm= 10m /ha). **(Doorenbos and Pruitt 1992).** Evapotranspiration ETo demand varies daily according to crop growth stages , amount and frequency of witting of the soil surface , environmental conditions, and crop management **(Allen *et.al.*2011).** The cost of hand labour nessicates the search for cheaper method like the use of herbicides. Oxyfluorfen was evaluated for weed

control in garlic. Only 0.7 kg oxyflurofen/ha applied 2 or 29 days after planting which gave good season-long control without phytotoxicity **(Nortje and Henrico 1985).** Oxyfluorfen at 0.3 kg/ha was most effective when applied once post-em. at the end of winter **(Durante and Cuocolo 1989).** Pendimethalin at 1.0 kg a.i./ha. +hand weeding at 30 days after sowing recorded the greatest control efficacy (93.1%) and bulb yield (4230kg/ha.) **(Naik *et al.* 2004).** Pendimethalin 30 EC at 2.5 and 1.87 kg/ha. resulted in significant increase in garlic bulb yield compared to weed free control **(Sandhu *et. al.* 1997).** Pendimethalin with manual weed control resulted in the greatest weed control and garlic yields **(Pandey *et al.* 1993).** Stomp (Pendimethalin 50% EC) at 1.25 - 2 litres /fed. applied pre- emergence in 200 litres water gave good selective weed control, but best bulb yields ,bulb weight and diameter and number of cloves/ bulb were obtained with hand hoeing **(Ahmed and Kandeel, 1991).** Pendimethalin at 0.5 kg/ha. as pre-emergence +2 hand weeding was found significantly superior in reducing population of monocots as well as dicot weeds. This treatment was also found beneficial for increasing growth characters, high of plant, leaves/plant, post harvest characters ,diameter of bulb ,length of bulb, weight of bulb and cloves bulb ,yield parameters, bulb yield of garlic and cost benefit ratio(2.98) **(Lina *et al.* 2011).** Pendimethalin in combination with manual hoeing gave the highest bulb yield and monetary returns **(Tariq *et al.* 2007).** The residues of pendimethalin in garlic plants on 28 DAA were 0.16 µg/g and 0.21 µg/g at application rates of 1.19 kg a.i. /ha and 2.38 kg a.i. /ha, respectively. **Lin *et al.* (2007).** Weed competition can cause extreme loss garlic yield and water use efficiency become minimal. Little information about this issue are available and is a big need about water and garlic crop. Thus, the present work was designed to find out the efficiency of some herbicides only or with hand hoeing under two soil moisture levels.

Materials and Methods:

Two field experiments were carried out in clayey loamy soil during 2016/2017 and 2017/2018 winter successive seasons at the Horticulture Research Station, El-Kanater El-Khiria, Kalubia Governorate to study was to evaluate the efficiency of two herbicides (Pendimethalin and Roal each alone and /or supplement with hand hoeing once under two irrigation levels *i.e.* 100 and 75 % of evapotranspiration potential (ETc) for controlling weed associated with garlic yield and its components as well as the determination of residues of both herbicides in garlic bulb. Garlic Balady cloves were planted on 12 and 28 October and harvested on 3 and 19 April for the first and second seasons, respectively, and were planted in hills at 10 cm apart within each row. The plot area was 10.5 m^2 (3.5 m length x 3 m width) and each plot consisted of five ridges 3.5 m length and 60 cm width. Planting was done on both sides of each hill. The normal cultural practices were carried out according to the local recommendations. Twelve treatments were replicated four times and distributed in split-plot design with four replicates were used as follows:

I- In main plots: included two irrigation levels:

1) 75 % Irrigation level: Irrigation with amount of water equals to 75 % of potential evapotranspiration (ETc)/ fed..
2) 100 % Irrigation level: Irrigation with amount of water equals 100 % of (ETc)/ fed.

II-The sub- plot was included six weed control treatments as follows:

1) Pendimethalin [N-(1-ethylpropyl) -2, 6-dinitro-3, 4-xylidine], which is known commercially as Stomp extra 45.5% CS, applied at the rate of 1.7 L. /fed. after planting garlic cloves immediately.
2) Pendimethalin at 1.7 L. /fed. applied after planting the garlic cloves, immediately, followed by one hand hoeing after one month from planting.
3) Oxyfluorfen (2-chloro -1- (3- ethoxy -4-nitrophenooxy) 4- (trifluoromethyl) benzene known commercially as Roal 24% EC, was applied at 750 cm^3/fed. after planting the garlic cloves immediately.
4) Oxyfluorfen at 750 cm^3/fed. applied after planting the garlic cloves, immediately ,plus hand hoeing once after month from herbicide application.
5) Hand hoeing two times at 21 and 42 days after planting.
6) Unweeded control, allowing weeds to grow with garlic plants without control.

The herbicides were sprayed by knapsack sprayer CP3 with water volume of 200 L. / fed.

The experimental soil was clay loamy in texture and bulk density as well as water-soil characteristic is shown in Tables 1 and 2. Meteorological data for El-Kanater El-Khiria, Research Station are shown in Table 3.

Table 1. Physical properties of the experimental soil.

Parameter	Value
Particle size distribution (%):	**%**
Clay	37.2
Silt	50.5
Fine sand	11.2
Coarse sand	1.1

Table 2. Water parameters and bulk density.

Depth in soil (cm)	Field capacity (FC) % (w/w)	Wilting Point (WP) % (w/w)	Available water (AW) % (w/w)	Bulk density (BD) gm/cm^3
0-15	38.8	18.5	20.3	1.20
15-30	36.7	17.2	19.5	1.26
30-45	33.5	16.5	17.0	1.28
45-60	30.3	15.9	14.4	1.32

Table 3. Meteorological data in 2016/17 and 2017/18 seasons.

Month	Temperature max °C	Temperature Minimum °C	wind speed (m/sec)	relative humidity (%)	actual sun shine (hour)	solar radiate (cal/ cm^2/ day)	rainfall (mm / month)
			2016/2017 season				
October	31.7	19.2	3.6	55	11.3	414	6.4
November	26.0s	14.4	3.6	61	10.5	319	14.3
December	20.6	9.6	3.7	64	10.1	260	4.6
January	18.2	*6.8*	3.9	60	10.3	276	19.4
February	23.7	9.1	3.6	51	11.1	350	1.5
March	26.4	11.3	4.1	43	11.8	438	5.6
April	32.8	14.2	4.2	37	12.8	516	1.3
			2017/2018 season				
October	32.0	17.8	3.8	55	11.0	417	28.6
November	26.5	14.0	3.6	54	10.2	280	36.0
December	21.5	10.5	4.5	64	10.1	260	44.8
January	17.7	10.8	5.4	64	10.2	280	1.0
February	20.8	9.2	3.2	66	11.1	354	5.3
March	25.8	11.2	3.6	61	11.5	441	0.0
April	31.7	13.5	5.9	57	12s.3	519	22.0

Calculation of evapotranspiration and crop coefficient:

Reference evapotranspiration (ETo), is the estimation of the evapotranspiration from the reference surface or climate (radiation, temperature and wind speed) + reference surface active growing under optimal conditions and was calculated using the meteorological data as cited by **Doorenbos and Pruitt, (1977)** and **Allen *et al.*, (1998)** as follows: -

The Penman- Monteith equation for estimating potential evapotranspiration Penman Monteith was applied by using CROP WAT model **(Smith 1991)** in Table 4.

Table 4. Estimate the reference crop evapotranspiration ETo and ETc in mm/day and in mm/month in 2016/ 2017 and 2017/2018 seasons.

Season		2016/2017		2017/2018		2016/2017		2017/2018	
		ETo				ETc			
Month	**Kc**	**mm /day**	**mm /month**	**mm /day**	**mm /month**	**Mm /day**	**mm /month**	**mm /day**	**mm /month**
October (12-28 day)	0.45	4.86	58.3	4.38	122.6	2.19	41.6	1.97	37.4
November	0.60	3.11	93.3	2.96	88.8	1.87	56.0	1.78	53.3
December	0.75	2.22	68.8	2.23	69.1	1.67	51.6	1.67	51.8
January	1.0	2.1	65.1	3.21	99.5	2.10	65.1	3.21	99.5
February	0.90	3.19	89.3	3.29	92.1	2.87	80.4	2.96	82.9
March	0.75	4.53	140.4	4.83	149.7	3.40	105.3	3.62	112.3
April (19 - 3 day)	0.70	6.1	115.9	7.64	22.9	4.27	81.1	5.35	16.0
Seasonal (mm)			631.1		644.7	S	481.1		453.3

Table 5. Monthly and seasonal applied irrigation water to garlic by irrigation system in 2016/17 and 2017/18 growing seasons.

Season	2016/2017				2017/2018			
	75 % ETc		100 % ETc		75 % ETc		100 % ETc	
Month	m^3 /day	m^3 /month	m^3 /day	m^3 /month	m^3 /day	m^3 /month	m^3 /day	m^3 /month
October	10.60	201.4	14.13	268.5	9.55	181.5	12.74	242.0
November	9.04	271.3	12.06	361.7	8.61	258.2	11.48	344.3
December	8.07	250.1	10.76	333.5	8.11	251.3	10.81	335.0
January	10.18	315.5	13.57	420.6	15.56	482.2	20.74	643.0
February	13.91	389.6	18.55	519.4	14.35	401.8	19.13	535.7
March	16.46	510.4	21.95	680.5	17.56	544.2	23.41	725.6
April	20.69	393.2	27.59	524.2	25.92	77.8	34.56	103.7
Seasonal (m^3/fed.)		2331.4		3108.6		2196.9		2929.2

Crop Coefficient (Kc):

Different crops will have a different crop coefficient values resulting in varing water demand. Water is transformed into vapor and transported from the land surface to the atmosphere. Kc is the single crop coefficient, which averaged crop transpiration and soil evaporation dimensionless) Kc (the crop factor), mainly depends on the type of crop, the growth stage of the crop and the climate. The recommended values of Kc, in Table 4 according to **Doorenbos and Kasam (1986)** were used to estimate the ETc for the garlic plants under conditions of the experimental areas. The formula is as follows:

$$ETc = Kc \cdot ETo$$

ETc = Evapotranspition for growing season (mm/day).

Kc = Crop transpiration and soil evaporation (crop coefficient)

ETo = The ETc demand varies daily according to crop growth stage , amount and frequency of wetting of the soil surface , environmental condition and crop management ,or crop water need (mm/day).

Both ETc and ETo are expressed in the same unit usually in mm/day (as an average for the period of one month or in mm/month).Crop water requirement (the daily reference evapotranspiration) (mm/day).

The resulting ETc can be used as an irrigation manager schedule who an irrigation should occur and who much water should be put back into the soil. The measured (actual) evapotranspiration of considered period (mm/day).

Amount of applied irrigation water (AIW):

Depth of applied irrigation water was calculated according to the following equation:

$$AIW = (ETc/Ea)$$

Where:

AIW= amount of applied irrigation water.

ETc: water consumptive use (mm^3).

E_a: application efficiency (fraction) = 0.65 for surface irrigation system.

The quantity of water applied for each plot was calculated using the following equation as described by **Khurmi, 1984**:

$$Q = Ca.\ A\ \sqrt{2gh}$$

Where:

Q = the quantity of water applied in m^3s-1,

Ca= coefficient of discharge (0.6)

A = (ðd2/4)

Where:

ð = equal to 3.14, d^2 = inside radius square for the siphon tube

G = the gravity equal to 9.81 $m.s^{-2}$

h = the head of water in the main irrigation canal in m.

The data recorded as follows:

A-Water relation:

1-Water consumptive use (Cu):

Water consumptive use (Cu) value was determined by using Time Domain Reflectometry (TDR) sensor which measured the volumetric soil moisture for depth 0.6 m of soil before and after each irrigation. The TDR is widely used to measure soil water content according to **Cataldo *et al.* (2011).** The Cu value was calculated according to **Israelsen and Hansen (1962)** using the following equation:

$$Cu = \sum_{i=1}^{i=4} \frac{(\theta_2 - \theta_1)}{100} X\ D$$

Where:

Cu = water consumptive use or actual evapotranspiration, ETc (mm).

i = number of soil layer.

θ2 = soil moisture content after irrigation, (%, by volume).

θ1 = soil moisture content just before irrigation, (%, by volume).

d = depth of soil layer, (mm).

2-Water use efficiency (W.U.E) :

Applied irrigation water is used to describe the relationship between production and the amount of water applied. It was determination according to **(Jensen 1983).**

The following equation was used as follow:

$$W.U.E = \frac{\text{Garlic yield (kg/fed.)}}{\text{Consumed irrigation water m (m3/fed.)}}$$

Where:
Y= Bulb garlic yield (kg/fed.).
ETc= Actuel evapotranspiration for growing season (m^3/fed.) or the total amount of irrigation water used in the field for growth season.

B - On weeds:

Weeds were randomly hand pulled from one square meter from each plot after 21 days from the later treatment and classified to broad leaved, grassy and total weeds, then dry weight were recorded.

C- Vegetative growth:-

Ten plants from each experimental plot were taken at random is 135 days before harvest date to measure the following variables.

1) Plant height (cm).
2) Number of leaves/plant.
3) Fresh weight/ plant (g).

D - Yield and yield quality.

At harvest, bulb fresh yield per each plot were determined. After curing, cured yield per plot were measured, ten bulbs were taken randomly from each experimental plot to determine the average of the following characters:

1) Bulb diameter (cm).
2) Bulb fresh weight (g).
3) Bulb dry weight (g).
4) Clove weight (g).
5) Fresh yield (ton/fed).
6) Dry yield (ton/fed)

E – Determination economic for weed control in garlic.

Economic evaluation due to weed control treatments was calculated according to **(Heady and Dillon, 1961)** as follows:

Gross income = yield/ ton x price of ton.
Gross margin = gross income – total cost.
Benefit / cost ratio = gross income / total cost.

F - Herbicide residues in garlic cloves.

In the 2016/2017 winter season, at harvest the herbicides residues for Stomp Extra (pendimethalin) and Roal (oxyfluorfen) in garlic cloves were determined by using the Gas Liquid Chromatography method according to **Nguyen *et. al*. (2008)** in Central Agricultural Pesticides Laboratory.

G -Statistical analysis:

Mean values of each trait were subjected to the analysis of variance to test the significance as described by **Gomez and Gomez (1984).** Duncan means separation test and correlations were detected by using MSTAT C Ver. 4 software **(MSTAT C, 1985).**

Results and Discussion:

It could be noted that the experimental soil in the two seasons was moderately infested by both grassy and broadleaf weeds species. The weed species included *Portulaca olerachea* L (common purslane)*; Chenopodum album* L (common lambsquarters).*; Rumex dentatus (Deck) ; Euphorbia peplus* L (petty spurge).*; Urtica urens* L.(burning nettle) and *Malva parviflora* L.(cheeseweed) as annual broad-leaved weeds with infestation rates of 0.83 and.93 ton dry weight./fed in first and second seasons, respectively. Meanwhile, *Echinochloa colonum* L. (Jungle Rice)*; Phalaris minor* L (little seed Canary grass) and *Setaria viridis* L.(Green Foxtail) as annual grassy weeds with infestation rates of 0.52 and 0.54 ton dry weight/fed. in first and second seasons, respectively.

1-Effect of irrigation levels on:

1-1. Weeds:

It is noteworthy that there was much significant differences on dry weight of broadleaf weeds, grassy weeds and their total and crop yield and its components between the two irrigation levels used (Table 6). In spite of 100 % irrigation level gave the significant effect on increasing the two categories of weeds, is still superior on increasing yield and its components compared to 75 % irrigation level. Under irrigation level at100 % from ETc the increasing percentage of the dry weight of broadleaf weeds, grassy weeds and their total were 2.21, 2.65 and 2.38%, respectively, in 2016/2017 season and 7.08, 8.94 and 7.8 %, respectively, in 2017/2018 season compared with 75 % irrigation level.

Table 6. Effect of irrigation levels on dry weight of the annual weeds (g/ m^2) in 2016/2017 and 2017/2018 seasons.

Irrigation Level % ETc	Dry weight of weed (g/m^2)		
	Broad-leaved weeds	Narrow leaved weeds	Total annual weeds
		2016/17 season	
75	45.2b	30.3b	75.5b
100	46.2a	31.1a	77. 3a
		2017/18 season	
75	48.0b	30.2b	78.2b
100	51.4a	32. 9a	84.3a

1-2. Yield and its components

The data obtained for yield and yield components of garlic which are given in Table (7), irrigation level had significant effect on it. In the respective both seasons, the highest increasing percentage of plant height (cm), number of leaves/plant, fresh weight/ plant(g), bulb diameter (cm), bulb fresh weight (g), bulb dry weight (g), clove weight(g), fresh yield (ton/fed) and dry yield (ton/fed). was obtained by 100 % irrigation 7.23 and 5.16; 9.41 and 4.67; 9.14 and 8.53; 4.53 and 10.86; 4.62 and 3.56; 3.34 and 3.51; 20.89 and 22.97; 4.2 and 6.49 and 7.81 and 4.18%,respectively, more than 75 % irrigation level. That mean the best irrigation level on growth and yield of garlic was 100 % irrigation level in spite of weed species weight recorded high values in both seasons.

Table 7. Effect of irrigation levels on garlic yield and its component in 2016/2017 and 2017/2018 seasons.

Irrigation level % ETc.	Garlic characteristics								
	Plant height (cm)	No. of leaves /plant	Fresh weight/ plant (g)	Bulb diameter (cm)	Bulb fresh weight (g)	Bulb dry weight (g)	clove weight (g)	Fresh yield (ton/fed)	Dry Yield (ton/fed)
					2016/17 season				
75	69.2b	8.5b	101.8b	4.41b	74.5b	37.12b	1.58b	10.01b	4.99b
100	74.2a	9.3a	111.1a	4.61a	77.94a	38.36a	1.91a	10.43a	5.38a
					2017/18 season				
75	64.0b	8.4b	99.67b	3.96b	73.0b	36.51b	1.48b	9.09b	4.55b
100	67.3a	8.8a	108.1a	4.39a	75.67a	37.79a	1.82a	9.68a	4.74a

1-3. Water consumptive use (m^3/fed.) (CU) and water use efficiency (WUE):

The effect of irrigation level on Cu and WUE of garlic in both 2016/2017and 2017/2018 seasons are shown in Table (8) and Figs (1 and 2). Irrigation level at 100 % gave the highest value of water consumption, than irrigation level at 75 %, respectively. Means values of seasonal water consumptive use in m^3/fed. were; 2129 & 1653 and 2307 & 1768 m^3/fed. for irrigation levels at100 % and 75 % irrigation level in the first and second seasons respectively. The most probably explanation for these results is that more available soil moisture resulted from more irrigation times give chance for luxury consumption of water, which ultimately resulted in enhancing transpiration from garlic plants, in addition to irrigation level at 75 % gave the highest WUE values which comprised 3.04 and 2.58 kg of garlic/m^3 water consumed in 2016/2017 and 2017/2018 seasons, respectively. Similar treatment increased WUE by 19.69 &25.24%more than irrigation level at 100 % in 2016/2017 and 2017/2018 seasons. Irrigation by 75 % of ETc decreased garlic yield by 7.2 &4.2% in 2016/2017 and 2017/2018 seasons than irrigation by 100 % of ETc which considered not large compared with irrigation by 100 %of ETc. On other hand the save of water by Cu equal 476 &539 m^3/feddan accompanied with the increase in the water use efficiency by 19.69 &25.24%. This means that can irrigation by 75 % with minimal garlic yield reduction under the circumstances of irrigation water shortage condition. These findings could be attributed to higher evapotranspiration resulted irrigation level at 100 %. These findings could be attributed to higher evapotranspiration resulted irrigation level at 100 % while the yield was not proportioned with ETc increase, whereas under irrigation level at 100 % the reduction in ETc was more than the yield decrease. Similar results were mentioned by **Abdalla *et at.* (1990)** found that, the highest Cu occurred when irrigation was done upon reaching a moisture of 70 to 80 % of the field capacity and **Abdel Mawly and Zanouny (2005) and Yasser *et al*. (2009),** who mentioned that the efficiency of water use had decreased as the soil moisture was maintained high.

Table 8. Effect of irrigation levels on water consumptive use (m^3/fed.) (CU) and water use efficiency (WUE) in 2016/2017 and 2017/2018 seasons.

Season	2016/2017		2017/2018	
Irrigation level % ETc.	Water relation			
	CU (m^3/fed.)	WUE	CU (m^3/fed.)	WUE
75	**1653**	**3.04 a**	**1768**	**2.58a**
100	**2129**	**2.54b**	**2307**	**2.06b**

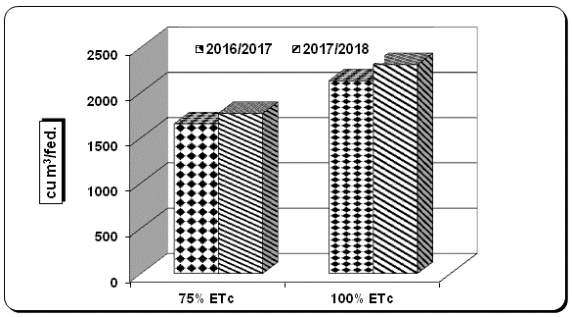

Fig 1: Effect of irrigation level on (Cu) for garlic in 2016/2017 and 2017/2018 seasons

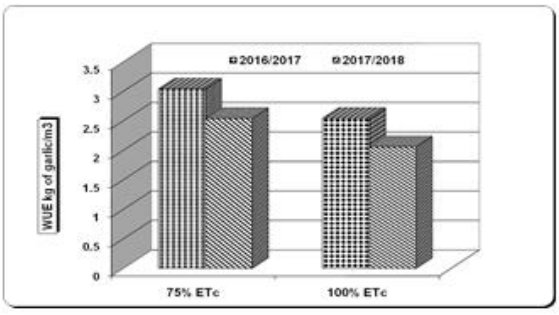

Fig 2: Effect of irrigation level on (WUE) for garlic in 2016/17 and 2017/18 seasons

2-Effect of weed control treatments on:

2-1. Weeds:

It was noticed that all herbicidal treatments and hand weeding exerted significant reduction percentage on the dry weight of presented weeds in both seasons. Stomp at 1.7 l/fed. plus hand hoeing integration reduced broad leaf, grassy and their total weight by 92.6, 91.4 and 92.2%, respectively , in the first season, and 93.6, 91.8 and 92.9 %,respectively ,in the second season. Roal at 750 cm^3/fed. plus hand hoeing integration gave the followed reducing of the previous respective weeds by 92.6, 90.6.and 91.9 % in the first season, and 93.1, 90.9 and 92.3% in the second season. While the efficacies of the rest of the weed control methods were in descending order as follows: Stomp at 1.7 l. /fed., Roal at 750 cm^3/fed. and hand hoeing compared to untreated (control) in both seasons.

Table 9. Effect of weed control treatments on dry weight of mixture annual weeds (g/ m^2) in 2016/2017 and 2017/2018 seasons.

Weed control treatment rate /fed.	Dry weight of annual weeds (g/m^2)		
	Broad leaf weeds	Narrow leaf weeds	Total
		2016/17 season	
Stomp at 1.7 l.	15.3c	11.9d	27.2d
Stomp at 1.7 l plus h.h.	14.6d	10.6e	25.2f
Roal at 750 cm^3	15.9Bc	12.7C	28.6C
Roal at 750 cm^3 plus h.h.	14.6d	11.5d	26.1e
Hand hoeing	16.4b	14.1b	30.5b
Unweeded check	198.4a	123.5a	321.9a
		2017/18 season	
Stomp at 1.7 l.	15.6cd	11.8d	27.4d
Stomp at 1.7 l plus h.h.	14.2e	10.5e	24.7e
Roal at 750 cm^3	16.1bc	13.1c	29.2c
Roal at 750 cm^3 plus h.h.	15.3d	11.7d	27.0d
Hand hoeing twice	16.4b	14.1b	30.5b
Unweeded check	220.9a	128.3a	349.2a

2-2. Yield and its components

Data presented in Table (10) show the effect of weed control treatments on garlic growth, yield and its components of garlic plants in both seasons. The increasing percentage of plant height (cm), number of leaves/plant, fresh weight/ plant(g), bulb diameter (cm), bulb fresh weight (g), bulb dry weight (g), clove weight(g), fresh yield (ton/fed.) and dry yield (ton/fed.) were obtained by Stomp at 1.7 l/fed. plus hand hoeing 19.8, 67.2, 287.9,22.7,45.4,44.8, 37.8, 19.5 and 33.8% ,respectively, followed by. Roal at 750 cm^3/fed. plus hand hoeing were 18.2, 36.1, 253.1,19.3, 43.9, 43.7,30.0 , 15.8 and 29.6%, respectively in the first season. Meanwhile, in the second season15.5, 71.4, 273.5, 32.7, 47.s8, 42.3, 63.6, 21.8 and 22.5%, respectively, was obtained by. Stomp at 1.7 l/fed. plus hand hoeing followed by. Roal at 750 cm^3/fed. plus hand hoeing were 13.0, 66.1, 244.6, 28.7,44.4,40.7,45.8,19.7,and 20.3 respectively, more than unweed check in both seasons. The rest of the efficacies of the weed control methods were in descending order as follows: Stomp at 1.7 l. /fed., Roal at 750 cm^3/fed. and hand hoeing compared to untreated (control) in both seasons.

2-3. Water consumptive use (m^3/fed.) (Cu) and water use efficiency (WUE).

Data presented in Table (11) and Figs (3 and 4) show the effect of weed control treatments water consumptive use (m^3/fed.) (Cu) and water use efficiency (WUE) in both seasons. All weed control treatments exhibited decreases in consumptive water use for each feddan than unweeded check by 8.04, 12.65,7.4, 3.26,8.95 and 6.525 in 2016/2017 season and 8.0, 11.74, 7.36,

8.94 and 6.43% in 2017/2018 season. This may be attributed to the high weight of weeds /m^2 which use water through the garlic growth season than under different weed control treatments. In an opposite trend, WUE tended to increase with weed control than unweeded by 28.52, 37.73, 25.64, 33.22 and 26.18in 2016/2017 season and 22.59, 21.27, 29.39, 24.18 and 20.94 in 2017/ 2018 season. This mean that weeds can compete strongly with garlic crop about irrigation water. It is evident that Stomp +hand hoeing and gave the highest WUE values, reached 3.26 and 2.62 kg /m^3 water consumed, respectively, in 2016/2017 and 2017/2018 seasons. Similar results were mentioned by **Dalley *et.al.* (2006)** they indicated weed density is important in depletion on soil moisture and has significant negative effects on the WUE.

Table 10. Effect of weed control treatments on garlic yield and its component in 2016/2017 and 2017/2018 seasons.

Weed control Treatment (rate /fed.)	Garlic characteristics								
	Plant height (cm)	No. of leaves /plant	Fresh weight/ plant (g)	Bulb diameter (cm)	Bulb fresh weight (g)	Bulb dry weight (g)	clove weight (g)	Fresh yield (ton/fed)	Dry Yield (ton/fed)
					2016/17 season				
Stomp at 1.7 l.	70.4c	9.6bc	120.4c	4.48b	78.70b	38.88b	1.85b	10.36c	5.25c
Stomp at 1.7 l plus h.h.	79.1a	10.2a	137.3a	4.87a	82.63a	40.77a	1.93a	10.86a	5.78a
Roal at 750 cm^3	70.8c	9.4c	112.9d	4.50b	78.50b	39.07b	1.72c	10.18e	5.06d
Roal at 750 cm^3 plus h.h.	78.0b	8.3d	125.1b	4.75a	81.80a	40.45a	1.82b	10.53b	5.60b
Hand hoeing	70.9c	10.0ab	107.5e	4.45b	78.87b	39.13b	1.73c	10.29d	5.15d
Unweeded check	66.0d	6.1e	35.43f	3.98c	56.83c	28.15c	1.40d	9.09f	4.32e
					2017/18 season				
Stomp at 1.7 l.	65.4c	9.1b	116.5c	4.12b	76.32cd	38.02d	1.73b	9.60ab	4.75b
Stomp at 1.7 l plus h.h.	69.3a	9.6a	132.33a	4.67a	81.92a	40.23a	1.93a	9.89a	4.90a
Roal at 750 cm^3	65.8c	9.2b	109.7d	4.03b	75.63d	38.07d	1.67c	9.49b	4.70b
Roal at 750 cm^3 plus h.h.	67.8b	9.3Ab	122.1b	4.53a	80.05b	39.77b	1.75b	9.72ab	4.81ab
Hand hoeing	65.6c	8.9b	107.4e	4.17b	76.68c	38.55c	1.63c	9.51b	4.71b
Unweeded check	60.0d	5.6c	35.43f	3.52c	55.42e	28.27e	1.18d	8.12c	4.00c

Table 11. Effect of weed control treatments on Water consumptive use (m^3/fed.) (Cu) and water use efficiency (WUE) in 206/2017 and 2017/2018 seasons.

Season	2016/2017		2017/2018	
Weed control treatment (rate /fed.)	Water relation			
	CU (m^3/fed.)	WUE	CU (m^3/fed.)	WUE
Stomp at 1.7 l.	1875.5	2.84	2017.5	2.39
Stomp at 1.7 l plus h.h.	1781.5	3.26	1935.5	2.62
Roal at 750 cm^3	1888.5	2.73	2031.5	2.35
Roal at 750 cm^3 plus h.h.	1857	3.04	1997	2.44
Hand hoeing twice	1906.5	2.75	2052	2.34
Unweeded check	2039.5	2.03	2193	1.85

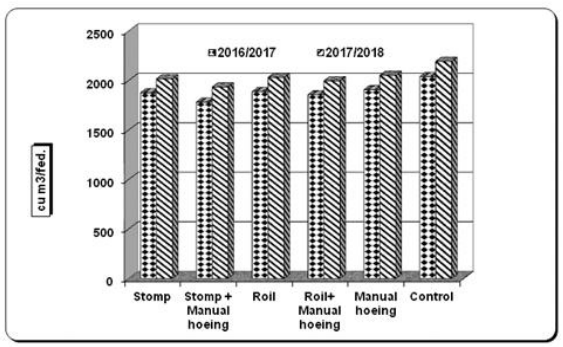

Fig 3: Effect of weed control treatments on (CU) for garlic in 2016/2017 and 2017/2018 season.

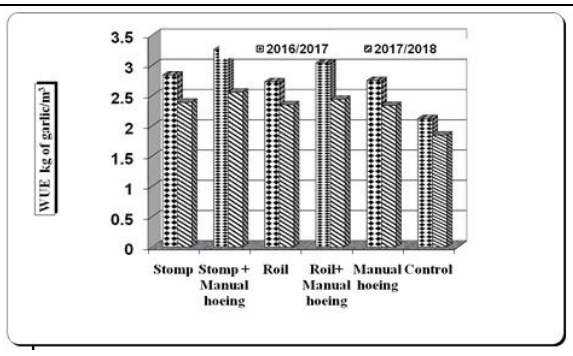

Fig 4: Effect of weed control treatments on (WUE) for garlic in 2016/2017 and 2017/2018 seasons.

3 - Effect of interaction between the two soil irrigation levels and weed control treatments on:

3-1. Weeds:

The effect of interaction between two irrigation levels and weed control treatments caused significant reduction in the dry weight of weeds in both seasons (Table 12). The application of Stomp at 1.7 l/fed. plus hand hoeing with 75 % irrigation level gave the highest reduction percentage in dry weight of the total annual weeds compared to the interaction between untreated control with 100 % irrigation level. The same weed control treatment with 100 % irrigation level gave the second highest reduction in the dry weight of the total annual weeds then the application of Roal at 750 cm^3/fed. plus hand hoeing with75 % irrigation level or 100 % irrigation level gave the following reduction in the two weed categories and their total in both seasons. Furthermore, the interactions between. Stomp at 1.7 l/fed. with75 % irrigation level or 100 % irrigation level reduced the dry weight of the two weed categories and their total and the interaction between Roal at 750 cm^3/fed. with75 % irrigation level or 100 % irrigation level and later the interaction between hand hoeing with75 % irrigation level or level or 100 % irrigation level. It can be concluded that using Stomp at1.7 l/fed. plus hand hoeing together to improve controlling weeds and gave garlic plants chance to grow well without weed competition with 75 % irrigation level. to grow well without weed competition with 75 % irrigation level.

Table 12. Effect of interaction between irrigation levels and weed control treatments on dry weight of mixture annual weed during 2016/2017 and 2017/2018 seasons.

Irrigation level % ETc	Weed control treatment rate /fed	Dry weight of annual weeds(g/m^2)					
		2016/2017 season			2017/2018 season		
		Broadleaf	Grassy	Total	Broadleaf	Grassy	Total
75	Stomp at 1.7 l.	15.1ef	11.7fg	26.8g	15.5ef	11.3fg	26.8fg
	Stomp at 1.7 l plus h.h	13.4g	10.5h	24.9j	13.8h	9. 3h	23.1h
	Roal at 750 cm^3	15.8c-e	12.4ef	28.2ef	15. 7d-f	12.6e	28.3e
	Roal at 750 cm^3 plus h.h	14.3fg	11.3gh	25.7hi	15.1fg	11.3fg	26.4fg
	Hand hoeing twice	16.3cd	13.7cd	30.0cd	16.1c-e	13.4d	29.5d
	Unweeded check	196.5b	122.5b	319.0b	211.7b	122.6b	334.3b
100	Stomp at 1.7 l.	15.4de	12.2f	27.6fg	15.7c-f	11.9ef	27. 6ef
	Stomp at 1.7 l plus h.h	13.8g	10.6h	24.4ij	14.5gh	11.1g	25.6g
	Roal at 750 cm^3	15.9c-e	13.0de	28.9.de	16.5cd	13.5d	30.0d
	Roal at 750 cm^3 plus h.h	14.9ef	11.7fg	26.6de	15. 3ef	12.1ef	27.4ef
	Hand hoeing twice	16.5c	14.5c	31.0c	16. 7c	14.7c	31.4c
	Unweeded check	200.3a	124.5a	324.8a	230.2a	134.0a	364.2a

3-2.Garlic yield and its component:

Results in Table (13) showed that effect for interaction between irrigation level and weed control treatments were statistically significant on growth characteristics of garlic plants which expressed in terms of plant height (cm), number of leaves/plant, fresh weight/ plant (g), bulb diameter (cm), bulb fresh weight (g), bulb dry weight (g), clove weight (g), fresh yield (ton/fed) and dry yield (ton/fed.) in both seasons. In the first season, showing that 100 % irrigation level with Stomp at 1.7 l plus hand hoeing gave the highest increasing percentage of this characters were 25.8, 71.7, 374.3, 25.0, 53.6, 50.0 , 100.0 ,28.2 and 48.5 %, respectively followed by the effect100 % irrigation level with Roal at 750 cm^3 plus hand hoeing of the same characters 23.6, 66.7, 316.0, 20.0, 54.7, 51.1, 81.8, 23.9 and 45.1% more than the interaction between 75 % soil moisture level with nuweeded check. Meanwhile, in the second season 21.3, 81.5, 355.4, 36.4, 54.1, 48.0, 110.0, 28.4 and 25.6%, respectively, was obtained by the interactions between100 % irrigation level with Stomp at 1.7 l plus hand hoeing followed by the interaction betweent100 % soil irrigation level with Roal at 750 cm^3 plus hand hoeing for this characters, were 18.6, 75.9, 308.1, 45.5, 50.2, 45.5, 90.0, 26.4 and 23.8 more than the interaction between75 % irrigation level with nuweeded check **3-3.Water consumptive use (m^3/fed.) (Cu) and water use efficiency (WUE):**

Results in Table (14) and Figs (5-8) showed that effect for interaction between irrigation level and weed control treatments were statistically significant on water consumptive use (m^3/fed.) (Cu) and water use efficiency (WUE) in both seasons. Stomp + hand hoeing under watering by irrigation level at 75 % from ETc recorded the lowest values from Cu which were 1601 and 1712 cubic meter of water /fed. in1601 and 1712 cubic meter of water /fed. in 2016/2017 &2017/2018 seasons ,respectively. It is evident that irrigation level 75 % gave the highest WUE values, reached 3.04 and 2.58 kg /m^3 water consumed, respectively, in 2016/17 and 2017/18 seasons. In addition, irrigation level at 100 % gave the lowest WUE values which comprised 2.54 and 2.06 kg/m^3 water consumed in 2016/17 and 2017/18 seasons, respectively. These findings could be attributed to higher evapotranspiration resulted irrigation level at 100 % while the yield was not proportioned with ETc increase, whereas under irrigation level at 100 % the reduction in ETc was

more than the yield decrease. also Stomp + hand hoeing under watering by irrigation level at 75 % from gave the highest value of water use efficiency were 3.42 and 2.82kg of garlic /m^3 such treatment can save irrigation water 671 and 481 m^3, respectively in both seasons compared with unweeded check with irrigation level at 100 %.

Table 13. Effect of interaction between irrigation levels and weed control treatments on growth, yield and its component at 2016/2017 and 2017/2018 seasons.

Irrigation level % ETc	Weed control treatment (rate /fed.)	Garlic characteristics								
		Plant height (cm)	No. of leaves /plant	Fresh weight/ plant (g)	Bulb diameter (cm)	Bulb fresh weight (g)	Bulb dry weight (g)	clove weight (g)	Fresh yield (ton/fed)	Dry Yield (ton/fed)
		2016/17 season								
75	Stomp at 1.7 l.	67.5f	9.4cd	115.3f	4.4cd	77.6d	38.5e	1.7ef	10.24d	5.16bc
	Stomp at 1.7 l plus h.h.	78.1c	10.1ab	128.9b	4.8ab	81.3b	40.4b	1.7e	10.72b	5.48b
	Roal at 750 cm^3	67.4f	9.1d	106.8g	4.4cd	76.9c	38.2e	1.6f	10.05e	4.99c
	Roal at 750 cm^3 plus h.h.	70.6e	6.5e	122.6d	4.7a-c	79.0c	39.5cd	1.7e	10.42c	5.25bc
	Hand hoeing	67.9f	9.9a-c	106.7g	4.4cd	77.6d	38.8de	1.6f	10.03e	4.95c
	Unweeded check	63.6g	6.0e	30.7i	4.0e	54.7f	27.4g	1.1g	8.59g	4.1e
100	Stomp at 1.7 l.	73.2d	9.8a-c	125.5cd	4.6bc	79.8c	39.3cd	1.9c	10.43bc	5.34b
	Stomp at 1.7 l plus h.h.	80.0a	10.3a	145.6a	5.0a	84.0a	41.1a	2.2a	11.01a	6.09a
	Roal at 750 cm^3	74.2d	9.6b-d	119.1e	4.6bc	80.1bc	39.9bc	1.8d	10.32cd	5.14bc
	Roal at 750 cm^3 plus h.h.	78.2b	10.0a-c	127.7bc	4.8ab	84.6a	41.4a	2.0b	10.64b	5.95a
	Hand hoeing	74.0cd	10.1ab	108.3g	4.5bc	80.2bc	39.5cd	1.8d	10.56c	5.35b
	Unweeded check	68.4f	6.2e	40.2h	4.1de	59.0e	28.9f	1.2ef	9.6f	4.41d
		2017/18 season								
75	Stomp at 1.7 l.	63.9d	8.8cd	114.0d	4.0cd	74.8fg	37.4f	1.6e	9.31c-e	4.65cd
	Stomp at 1.7 l plus h.h.	67.9bc	9.4a-c	124.9b	4.4b	80.3c	39.2cd	1.7c	9.65a-d	4.83a-c
	Roal at 750 cm^3	64.4d	8.9b-d	104.4f	3.9d	74.1g	37.3f	1.5f	9.17de	4.59d
	Roal at 750 cm^3 plus h.h.	66.4c	9.2b-d	118.9c	4.3bc	78.7d	39.4c	1.6d	9.47b-e	4.73b-d
	Hand hoeing	63.2de	8.7d	105.2f	4.0cd	75.9f	38.1e	1.5f	9.09e	4.55d
	Unweeded check	58.3f	5.4e	30.7h	3.3e	54.2i	27.7h	1.0h	7.89f	3.95e
100	Stomp at 1.7 l.	66.9c	9.4a-c	119.0c	4.2bc	77.8de	38.7de	1.9b	9.89ab	4.85a-c
	Stomp at 1.7 l plus h.h.	70.7a	9.8a	139.8a	4.5a	83.5a	41.0a	2.1a	10.13a	4.96a
	Roal at 750 cm^3	67.2c	9.4a-c	115.0d	4.2bc	77.1e	38.8cd	1.9b	9.81a-c	4.81a-c
	Roal at 750 cm^3 plus h.h.	69.2ab	9.5ab	125.3b	4.8a	81.4b	40.3b	1.9b	9.97ab	4.89ab
	Hand hoeing	68.0bc	9.2b-d	109.5e	4.4b	77.5e	39.0cd	1.8c	9.92ab	4.87ab
	Unweeded check	61.8e	5.8e	40.2g	3.7	56.7h	28.8g	1.4g	8.32f	4.06e

Table 14. Effect of interaction between irrigation levels and weed control treatments on water consumptive use (m^3/fed.) (CU) and water use efficiency (WUE). 2016/2017 and 2017/2018 seasons.

Irrigation level % ETc	Weed control Treatment (rate /fed.)	2016/2017 season		201720/18 season	
		Cu	WUE	Cu	WUE
75	Stomp at 1.7 l.	1632	3.16b	1747	2.66b
	Stomp at 1.7 l plus h.h.	1601	3.42a	1712	2.82a
	Roal at 750 cm^3	1625	3.07	1739	2.64b
	Roal at 750 cm^3 plus h.h.	1632	3.22b	1746	2.71ab
	Hand hoeing	1622	3.05b	1736	2.62b
	Unweeded check	1807	2.12e	1931	204f
	Mean	1653	3.04A	1768	2.58A
100	Stomp at 1.7 l.	2119	2.52d	2288	2.12de
	Stomp at 1.7 l plus h.h.	1962	3.1b	2159	2.30c
	Roal at 750 cm^3	2152	2.39d	2324	2.07de
	Roal at 750 cm^3 plus h.h.	2082	2.86c	2248	2.17d
	Hand hoeing	2191	2.44d	2368	2.06de
	Unweeded check	2272	1.94f	2455	1.65se
	Mean	2129	2.54B	2307	2.06B

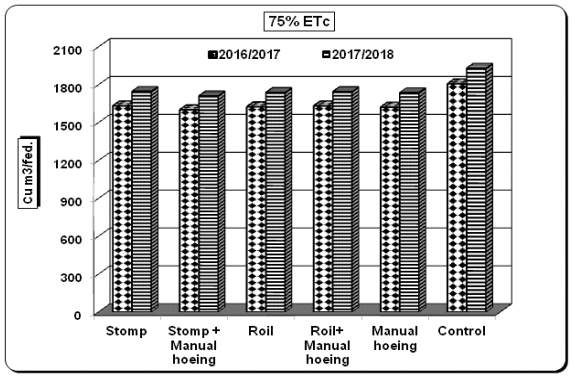

Fig 5: Effect of the interaction between irrigation level at 75 % and weed control treatments on (CU) for garlic in 2016/2017 and 2017/2018 seasons.

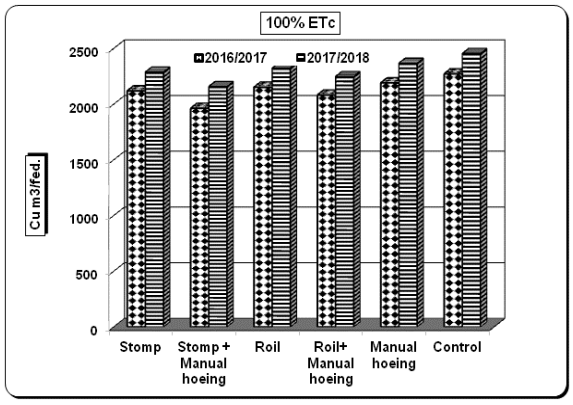

Fig 6: Effect of the interaction between irrigation level at 100 % and weed control treatments on (CU) for garlic in 2016/2017 and 2017/2018 seasons.

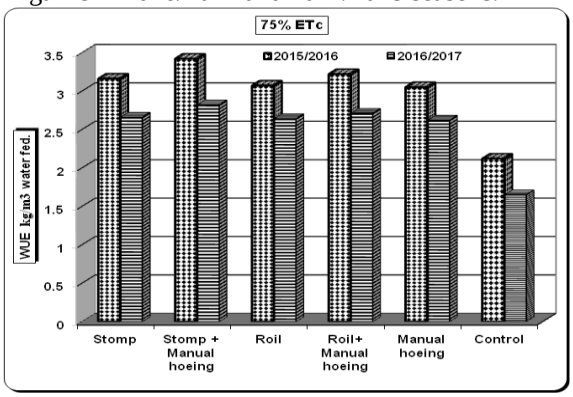

Fig 7: Effect of the interaction between irrigation level at 75 % and weed control treatments on (WUE) for garlic in 2016/2017 and 2017/2018 seasons.

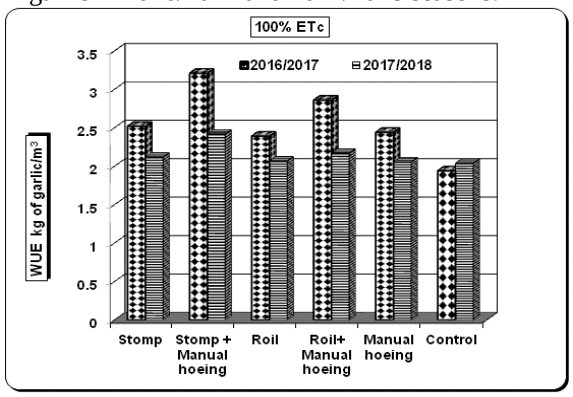

Fig 8: Effect of the interaction between irrigation level at 100 % and weed control treatments on (WUE) for garlic in 2016/2017 and 2017/2018 seasons.

4. Herbicide residues detection in garlic yield bulb:

Data in Table (15) and Figs (9-12) demonstrated the stability of the two soil applied herbicides under this study and indicated that residues level of pendimethalin and oxyfluorfen were analyzed in garlic yield at harvest time. Herbicides once applied to the soil are in a dynamic state where are seven processes that begin to work on herbicides to alter their concentration and placements. These processes consist of: volatilization, photodecomposition, chemical decomposition, microbial decomposition, adsorption, and leaching and pant uptake. All of these processes are in some way affected by soil moisture from irrigation or rainfall. Soil moisture is involved in all of the seven dynamic processes which affect herbicides in the soil.It is critical to the placement, movement, break down and uptake of herbicides. The results show that both Pendimethalin and oxyflurofen were less than the allowable level according to **European Food Safety Authority (EFSA) (2012)** criteria and mean that there is no fear from herbicide residues in garlic yield at harvesting.

Table 15. Residues for Pendimethalin and Oxyfluorfen garlic yield.

Sample	Residual in garlic	MRL (mg/ kg)	Acceptable daily level (mg/ kg)
Pendimethalin	0.00112	0.05	0.125
Oxyfluorfen	0.00115	0.05	0.03

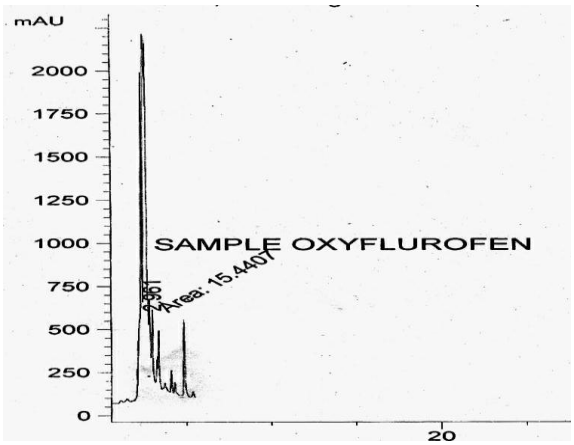

Fig 9: Sample of Pendimethalin in garlic

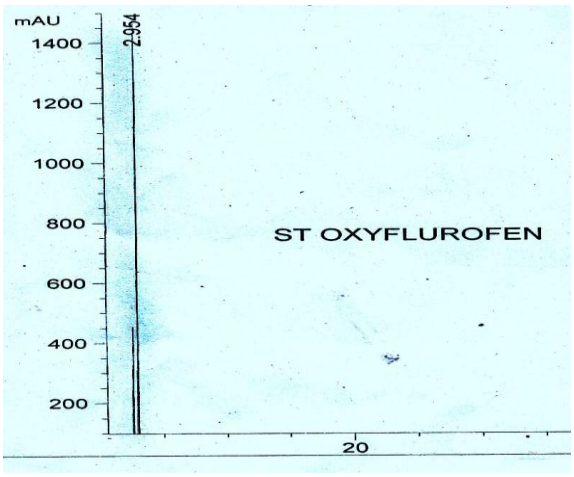

Fig 10: Standard of Pendimethalin

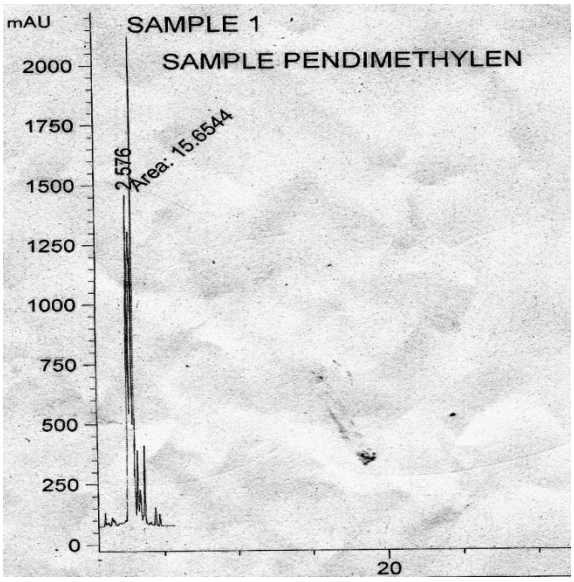

Fig 11: Sample of oxyflurofen in garlic

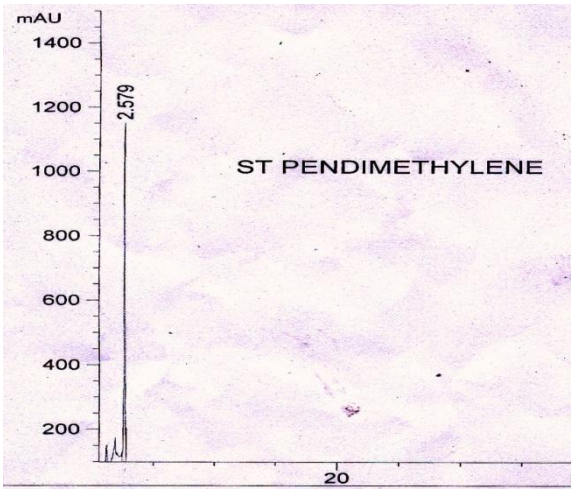

Fig 12: Standard of oxyflurofen

5- Economic feasibility for weed control in garlic

Economic evaluation in Table (16) show that value of the profitability was with Stomp at 1.7 l plus hand hoeing and Roal at 750 cm^3 plus hand hoeing were 1.2 and 1.18% under irrigation level 75 % and 1.31&1.29 under irrigation level 100 %, respectively. in the first season. In the second season value of the profitability was with Stomp at 1.7 l plus hand hoeing and Stomp at 1.7 l plus hand hoeing were 1.1.18 and 1.17% under irrigation level 75 % and 1.21&1.2 under irrigation level 100 %, respectively. in the first season. The rest of treatments were arranged according to increase profitability as follows Stomp at 1.7 l /fed Roal at 750 cm^3 and hand hoeing twice respectively.

Table 16. Determination economic for weed control in garlic during 2016/20/17 and 2017/2018 seasons.

irrigation level % ETc	Weed Control treatment (rate /fed.)	Characteristics							
		Total cost L.E.	Gross income L.E.	Benefit L.E.	B/C	Total cost L.E.	Gross income L.E.	benefit L.E.	B/C
	Season	2016/17 season				2017/18 season			
75	Stomp at 1.7 l.	10860	12642	1782	1.16	11880	13950	2070	1.17
	Stomp at 1.7 l plus h.h	11160	13426	2266	1.2	12280	14490	2210	1.18
	Roal at 750 cm^3	10740	12226	1486	1.14	11960	13770	1810	1.15
	Roal at 750 cm^3 plus h.h.	11040	12836	1796	1.18	12360	14190	1830	1.15
	Hand hoeing twice	11060	12128	1068	1.09	12380	13650	1270	1.12
	Unweeded check	10460	10045	-415	0.96	11580	11850	270	1.02
100	Stomp at 1.7 l.	11016	13083	2067	1.19	12170	14550	2380	1.2
	Stomp at 1.7 l plus h.h	11416	14921	3505	1.31	12570	15200	2630	1.21
	Roal at 750 cm^3	10890	12593	1703	1.16	12040	14430	2390	1.2
	Roal at 750 cm^3 plus h.h.	11290	14578	3288	1.29	12440	14970	2530	1.2
	Hand hoeing twice	11210	13108	1898	1.17	12530	14610	2080	1.17
	Unweeded check	10610	10804	194	1.02	11730	12180	390	1.04

Conclusion

It can be concluded that we can grow garlic by applying 75 % of ETc evapotranspiration and save about 476 &539 m^3 through both seasons with minimal yield reduction about 7.2 &4.2% compared with f full irrigation 100 % of ETc. Control weeds by the using of Stomp following by additional hoeing to save irrigation water which consumed by existed weeds in garlic field without residues and gave the highest values of gross income and net benefit.

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تأثير مستويات الرى و اضافة بعض المبيدات الارضية على الحشائش و كفاءة استخدام المياه و انتاجية محصول الثوم

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تم إقامة تجربتان حقليتان فى ارض طينيه خلال موسمى17/2016 و18/2017 فى محطة بحوث البساتين بالقناطر الخيرية بمحافظة القليوبية لدراسةمستويان من الرى هما 75 و100 % من كمية المياه المضافة (ETc) من الاستهلاك المائى مع ستة معاملات مكافحة للحشائش وهى نمبيد ستومب اكسترا بمعدل معدل 1.7 لتر / فدان ومبيد رول بمعدل 0.75لتر/الفدان منفردان وكذلك يضافس اليهما عزقة واحدة بعد شهر من الزراعة بالاضافة الى معاملة العزيق مرتين وكذلك معاملة الكنترول عى الحشائش ومحصوسل الثوم ومكوناته والعلاقات المائيه مثل الاستهلاك المائى وكفاءة استخدام ماء الرى. تم استخدام تصميم التجربة فى نظام القطع المنشقة مرة واحدة فى أربعة مكررات حيث وزعت مستويات الرى عشوائيا فى القطع الرئيسية بينما تم توزيع معاملات مكافحة الحشائش عشوائيا فى القطع المنشقة ز أوضحت النتائج ان تواجد الحشائش الحولية بمعاملة الكنترول كان 1.35 و1.47 طن وزن جاف للفدان للحشائش الحولية و احدث ذلك نقص فى المحصول مقداره 25.3 و18.4 % بالمقارنة بدون معاملة خلال موسمى التجربة.

الاختلافات فى مجموعات الحشائش وكذلك الاختلافات فى المحصول ومكوناته لمحصول الثوم تؤدى الى زيادة معنوية خلال موسمى التجربة وذلك مع اضافة ماء الرى بمعدل 100 %من الماء المضاف (ETc) بينما كفاءة استخدام المياه تميل الى الزيادة بمقدار 19.8و 25.2 باضفة ماء الرى بمعدل 75من الماء المضاف (ETc) خلال موسمى التجربة وكانت مجدية اقتصاديا وكان معدل استخدام المياه مع استخدام مبيد ستومب اكسترا بمعدل 1.7 لتر /الفدان ومبيد رول بمعدل 0.75 لتر /الفدان مضافا اليهما عزقة بعد شهر من الزراعة والعزيق مرتين تميل الالزيادة بمقدا 34.0 و 53.8 و 28.8 و43.4 و29.7 بالمقارنة بمعاملة الكنترول فى الموسم الاول وبمقدار 29.8 و38.4 و27.0 و31.9 و26.5 فى الموسم الثانى. وهذا راجع الى الانخفاض فى منافسة الحشائش. ادت معاملات مكافحة الحشائش الى تاثير معنوى فى مكافحة الحشائش وصفات النمو ومحصول الثوم ومكوناته. وادى تطبيق مبيد ستومب اكسترا بمعدل 1.7 لتر/الفدان ومبيد رول بمعدل 0.75 لتر / الفدان مضافا اليهما عزقة واحده اكبر تاثير وكذلك اعلى دخل. وادى استخدام مستويات الرى ومعاملات مكافحة الحشائش الى تاثير معنوى بسيط ويزداد نسبيا تحت مستوى رى 100 % من الماء المضاف (ETc). وبالنسبة لمتبقيات المبيدات تحت الدراسة فهى اقل من الحد المسموح.

لذا توصى هذه الدراسة بإستخدام كلا من مبيد ستومب أكسترا بمعدل 1.7 لتر/فدان او رول بمعدل750سم^3 كلاهما بعد الزراعة وقبل الرى مضافا اليه عزقة واحده بعد شهر من الزراعة وتحت مستوى رطوبة 100 % من الماء المضاف لأعطاء أفضل أنتاجية إقتصادية وجودة لمحصول الثوم للفدان تحت ظروف محطة بحوث البساتين بالقناطر الخيرية و بدون مخاطر من متبقيات المبيدات على محصول الثوم. يمكن الرى بمقدار 75 % عطاء محصول قدره 93 & 96% من محصول الثوم عند الرى بمقدار 100 % ب وبمقدار فقد 7&4 % فى المحصول ويقابل ذلك توغير 476& 539 م^3 اى ما يوازى ريتين حلال موسمى 2017/2016 و2018/2017.