

دراسة تأثير طرق الري على نمو وأنتاج الكرنب فى الوادى القديم

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الملخص العربى

أجريت هذه الدراسة بمحطة البحوث الزراعية بالجميزة - محافظة الغربية عام ٢٠١٠ لدراسة تأثير بعض طرق الري على انتاجية محصول الكرنب ونوعيته مع استخدام التسميد الحيوى.

وأظهرت النتائج الأتى:

١- استخدام الري السطحى مع الري بالرش أدى الى زيادة وزن النبات- قطر النبات- ارتفاع رأس النبات- ارتفاع النبات- طول جذر النبات- وزن جذر النبات- وزن المحصول بمعدل ١٣،٩- ٨،٦- ٦،٧- ٢٥- ٣٣،٣ - ١١،١١ - ٥٣،٨ % على الترتيب مقارنة بالرى السطحى.

٢- استخدام الري بالتنقيط مع الري بالرش أدى الى زيادة وزن النبات- قطر النبات- ارتفاع رأس النبات- ارتفاع النبات- طول جذر النبات- وزن جذر النبات- وزن المحصول بمعدل ١٥،١٩ - ٤٤،٢٤ - ٣٣،٧ - ٤٢،٨ - ٧٦،٨ - ٧١،٤ - ٧٦،٩ على الترتيب عن الري بالتنقيط.

٣- استخدام الري بالتنقيط اليومى أدى الى زيادة وزن النبات- قطر النبات- ارتفاع رأس النبات- ارتفاع النبات- طول جذر النبات- وزن جذر النبات- وزن المحصول بمعدل ٥،٥ - ١٥،٨ - ٢،٤ - ١٠ - ٢٥ - ٢،٤ على الترتيب عن الري كل ثلاثة أيام.

٤- استخدام الري بالتنقيط اليومى مع الري بالرش أدى الى زيادة وزن النبات- قطر النبات- ارتفاع رأس النبات- ارتفاع النبات- طول جذر النبات- وزن جذر النبات- وزن المحصول بمعدل ٦،٦٣ - ٦٣،٦ - ٦،١٢ - ٠ - ٨،١ - ٣،٣ - ١٠ - ٦،٦٣ على الترتيب عند الري كل ثلاثة أيام.

٥- التسميد بمعدل ١ طن كومبوست للفدان أدى الى زيادة وزن النبات- قطر النبات- ارتفاع رأس النبات- ارتفاع النبات- طول جذر النبات- وزن جذر النبات- وزن المحصول بمعدل ٤,٩ - ٨,٣٣ - ١٧,٣ - ٢٧,٥ - ٥٨,٦ - ٢١ - ٧١,٣ على الترتيب عن التسميد بمعدل ٠,٥ طن للفدان.

٦- للحصول على أعلى إنتاجية وتحسين مواصفات الأنتاجية لمحصول الكرنب الصيفى تحت ظروف منطقة الجميزة غربية نوصى بتطبيق طريقة الري بالرش فى منتصف موسم النمو مع طريقة الري بالتنقيط اليومى الذى يعمل على خفض درجة الحرارة مع التسميد الحيوى بمعدل واحد طن كومبوست للفدان.

CABBAGE GROWTH AND YIELD AS INFLUENCED BY IRRIGATION METHODS IN OLD VALLEY

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ABSTRACT: *In order to develop techniques that environment temperature in Gemmiza Agricultural Research Station during summer season 2010 . An experiment carried out the yield of cabbage was maintained at high level by use of irrigation. Yield in winter is bigger than in summer , so we applied sprinkler irrigation plus for both furrow and drip irrigation to make the same conditions in the summer season to be like condition rain fall to overcome temperature raising in the summer. Improve some plant characteristics due to using sprinkler plus furrow irrigation increasing by 13.9 , 8.6 , 6.7, 25 ,33.3 and 11.11 % respectively. Compared with furrow irrigation for mean head diameter , mean head height , plant height , root length(cm) , mean head weight and fresh root weight (kg) . The increasing in drip plus sprinkler 19.15 , 24.4 , 33.7 , 42.8, 76.8 and 71.4 % compared by drip irrigation . The yield increase by 53.8 %in furrow plus sprinkler compared furrow irrigation*

The increasing in drip plus sprinkler about 77 % compared with drip irrigation .

Effect of fertilizer on some x characteristics on mean head diameter; mean head height ; plant height ; root length (cm) mean head weight ; and fresh root weight (kg) due to use 1 ton /fed compost were increased by 4.9, 8.33, 17.3, 27.5, 58.6 and 21.0% respectively compared with using 0.5 ton compost /fed .

Effect of fertilizer on yield by using ` 1 ton compost / fed increased the yield by 58.3 % comparing with using 0.5 ton /fed .

Effect of irrigation interval on mean head diameter ; mean head height ; plant height and root length(cm) , mean head weight and fresh root weight (kg) showed that increasing of 2.5 , 5.5 15.8, 2.4, 10.0 ,and 25 % respectively

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compared by drip with interval of three days . for the treatment of drip plus sprinkler irrigation with daily irrigation the increasing were 63.6, 12.6 , 0.0 , 1.8 , 3.3 and 10.0 % respectively

Effect of irrigation interval on yield increase by 2.4 % For drip interval of three days, Also when applied drip plus sprinkler daily, the yield increased by 63.6 % compared with drip plus sprinkler every three days .

Key words: *Irrigation methods ,reference evapotranspiration (ET_o) Cabbage yield , water use efficiency*

INTRODUCTION

Cabbage is scientifically known as *brassica oleracea var. capitata*. It belongs to the brassicaceae family. Today it is mainly used as a fresh market crop for cooking and making of salads. Cabbage is widely growing in the world and annual production about 55 million ton of fresh head from 2.6 million ha. in Egypt delta about 35 thousands feddans are cultivated with green cabbage. According to FAO, Cabbage water requirement and irrigation scheduling depend on climate; crop development and soil type. For these reasons, it is very important to research ideal irrigation methods to applying with cabbage crop. Ciftci *et al*, 1994 reported that in konya, region of turkey where the study was conducted total annual rainfall is almost 300 mm and only 130 mm of it precipitation during the crop growth period . thus, irrigation is vital important in especially summer season. Sprinkler irrigation system is mostly used (70%) and is followed by furrow, border. basin and drip irrigation methods, respectively. Solomn 1988 . reported that the losses in surface irrigation methods are direct evaporation from the soil surface, runoff leakage in water delivery systems. The runoff losses may be minimized by diverting the water stored lower end of field to the upper part. The leakage losses in unlined delivery systems or open fields Canals depend on the soil texture of canals, length of canal network and average of 10-15%. Keller and bleisner, 1990;li, 1998. reported that the primary losses associated with sprinkler irrigation are evaporation from droplets and wet soil surfaces ; transpiration from unwanted vegetation, wind drift, field border losses, leak and system drainage. Prabhat *et al*. 1999. studies about the effect of trickle, micro sprinkler and surface irrigation methods on yield of cabbage in India. The yields were found 38.97, 40.23, and 33.76 t/ha for trickle, micro sprinkler and surface irrigation methods, respectively. maggio *et,al*. 2005 and jamil *et,al* 2005. both observed significant reduction in head fresh weight with irrigation water with an E_{cw} around 4 dsm^{-1} . Under ideal climatic conditions; good irrigation methods; crop management and well fertilized , yields can be as high as 85 ton/ha fresh head and the utilization efficiency for harvested yield for head is about 12 to 20 kg/m^3 (FAO home) Ayers and Westcott (1985).reported that cabbage is moderately sensitive to the salinity of irrigation water and suggest a threshold electrical conductivity for

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irrigation water, E_{cw} , of 1.2 dsm^{-1} for maximum yield. Beltrao *et al.*, (2000) found that yields decreased linearly with increasing E_{cw} above 2 dsm^{-1} . Mggio *et al.*, (2005) and Jamil *et al.*, (2005) both observed significant reductions in head fresh weight with irrigation water with an E_{cw} around 4 dsm^{-1} associated with reduced leaf area and above ground dry mater. Monastra *et al.* (1994) stated that the use of 3 irrigation system I e drip, sprinkler and drip plus sprinkler on kiwifruit (Cv .Hayward) trained on horizontal trellises, were compared . the data showed that during the first 6 years of the 10 tear trial , the integrated system (drip +sprinkler) induced the greatest plant development and slightly. The drip system provided better water distribution a long the pipeline than the sprinkler system and required less maintenance. The mixed system was the most efficient arrangement especially during the training phase of the orchard, although it had the highest costs for materials, energy and maintenance .it is recommended that system choice should be determined by economic evaluation of production costs. Arnaout (1995) . stated that the efficiency of any irrigation system depends on water supply in the desired time . The average irrigation efficiency of the drip irrigation system increased by about 15,87 and 38,37 % more than irrigation efficiency of sprinkler and furrow systems respectively . EL-Guindy, (1988) reported that the yield of tomato increased under drip irrigation by 33% and 35% over the furrow and sprinkler irrigation methods and by 54.5% and 54% over the furrow and sprinkler irrigated cucumber. Bitton,(1999) reported that the use of compost contributes to conservation by reducing both utilization of non-renewable resources and consumption of energy for waste treatment of chemical fertilizers. Composting indirectly also contributes to human safety by avoiding an improper fate or disposal of organic wastes. Sequi, (1996) reported that the composting is regarded as a fully sustainable practice, since it aims at both conservation of the environment, human safety and economically convenient production.

MATERIALS AND METHODS

The study was carried out during the period from June 2010 to October 2010 at Gemmeiza Res. Sta. farm to study cabbage growth and yield as influenced by irrigation methods in old valley . Transplanting date of cabbage were 12 June 2010 ;row spacing between 50 and 60 cm; plant were irrigated by furrow; drip and drip max sprinkler irrigation methods; irrigation water was applied to the plants when water depletion of 50- 60% from available water capacity of soil in furrow; drip interval was daily ;3days; drip; furrow max sprinkler irrigation methods was in mid season (50day) only ie 0.5 hour every 5 days. Fertilizers were incorporated before transplanting .

The adopted treatments were arranged in split split – plot experimental design with 3 replicates as follows.

Main – plot (irrigation interval)

Daily - Every three days 1-

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Sub main – plot (fertilizing rate)

1- Fertilizing by 1 ton compost /fed

2- Fertilizing by 0.5 ton compost /fed

Sub –sub main –plot (irrigation methods)

1 - furrow irrigation (FI)

2 – furrow irrigation plus sprinkler (FI+SI)

3 - Surface drip irrigation (DI)

4- Surface drip irrigation plus sprinkler (DI+SI)

The soil of the experimental site is clayey in texture and particale size distribution are shown in Table (1)

Table (1): Some physical properties of the soil for *GEMMEIZA* research station.

Soil depth (cm)	Particle size distribution %				Texture Class
	C.sand	F. sand	Silt	Clay	
0-----20	1.10	18.04	24.04	47.37	CLAY
20-----40	1.10	18.8	27.50	44.14	CLAY
40-----60	0.8	24.4	30.38	40.80	CLAY

In the Table (2, 3 and 4) shown that, Field capacity; wilting point , available water % , Some chemical properties soil and irrigation water for *GEMMEIZA* research station .

Table (2): Field capacity; wilting point and available water % for *GEMMEIZA* research station .

Soil depth (cm)	Soil moisture content (%)		
	Field capacity Wt/wt %	Wilting point Wt/wt %	Available water mm
0-----20	42.6	20.8	43.6
20 -----40	44.9	20.74	48.2
40-----60	46	21	50

Table (3): Some chemical properties for soil of *GEMMEIZA* research station.

Soil depth (cm)	Ph ^{2,5d}	Ec Dc\m	Soluble captions meq\l				Soluble anions meq\l				SAR
			++ Ca	++ Mg	+ Na	+ K	-- Co ³	- Hco ³	-- So ⁴	- Cl	
0----20	8.0	1.27	2.9	2.8	5.1	0.6	-----	3.6	2.0	6.1	5.31
20---40	8.1	1.25	2.9	2.1	0.7	0.7	-----	3.7	2.1	6.3	7.91
40--60	8.3	1.22	3.0	2.0	6.5	0.7	-----	3.9	2.1	6.5	4.11

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Table (4) Chemical analysis of irrigation water for GEMMEIZA station.

pH	EC Dsm ⁻¹	Soluble cat ions meq\l				Soluble anions meq\l				SAR
		++ Ca	++ Mg	+ Na	+ K	-- Co ³	- Hco ³	-- So4	- Cl	
7.5	1.6	5.0	4.80	7.78	0.85	-----	4.87	4.46	5.73	2..9

The lay out of the experimenta field (120× 18m) shown in fig. (1)

Fig 1

1 -Irrigation water calculations:

a. Furrow irrigation system.

$$Q = 0.16 \times A \times 0.443 \times H^{0.5} \quad \text{James (1988)-----(1)}$$

Where:

Q =Orifice discharge l/sec.

A = Cross section area of the orifice m²

H= Effective water head m.

b. drip irrigation.

c. sprinkler irrigation.

Table (5) shown Irrigation methods, discharge and Laterals diameter.

Table (5): Specifications of the studied irrigation methods.

Methods no.	Irrigation methods	discharge	Average discharge	Spacing	Laterals diameter
1	Surface drip	2 l / h	2.1 l/h	50 cm	16 mm
2	Sprinkler (AQUA)	0.2m ³ / h	0.18m ³ / h	(9m)diameter at preacher 2 bar-single nozzle 3mm	75 mm

D. Pan evaporation management.

Reference evapotranspiration (ET₀) was calculated according to (Doorenbos and Prutt (1977): as follow:

$$ET_0 = K_p \times E_{pan} \text{-----}(2)$$

Where :

ET₀ = reference evapotranspiration (mm / day)

K_p = pan coefficient

E_{pan} = pan evaporation (mm)

$$ET_{crop} = ET_0 \times K_c \quad (\text{mm/day}) \text{-----} (3)$$

Where:

ET crop = crop evapotranspiration (mm/day).

K_c = crop coefficient.

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Data in the Table (6) shown that, Crop coefficients (Kc) , ETo and Eta for cabbage .

Table (6): Crop coefficients (Kc) ;ET0 for location of kator weather station .

Stage Crop	Crop development stages				
	Initial	Crop development	Mid- Season	Late Season	At Harvest
Cabbage kc	0.45	0.75	0.98	0.95	0.65
ET0	7.0	5.9	2.8	2.6	-----
ETa	3.15	4.43	2.87	2.47	-----
Period	40 day	60 day	50 day	15 day	0

e. leaching requirements.

Leaching requirement (LR) estimated according to (Doorenbos and pruit,1977) by the following equation.

$$LR = \frac{ECw}{\frac{Max\ ECe - ECw}{ECw}} \text{ (for drip irrigation) } \text{-----} \text{ (4)}$$

$$LR = \frac{ECw}{5\ ECe - ECw} \text{ (for surface irrigation) where: } \text{-----} \text{ (5)}$$

ECw = electrical conductivity of irrigation water, dS/m.

ECe = electrical conductivity of the soil saturation extract dS/m.

Max ECe = maximum tolerable electrical conductivity of the soil saturation extract.

f. Water use efficiency (WUE)

was calculated by dividing the yield (kg/fed) by the total applied water (m³/fed) according to the equation of Vitas (1965) as follows.

$$WUE = \frac{CY}{AW} \text{-----} \text{(6)}$$

where

WUE = water use efficiency kg/m³

Cy = the cabbage fresh wt. (kg).

Aw = the amount of the applied water m³/fad.

g.Yield :

Yield was determined by ton / fed

RESULTS AND DISCUSSION

The objectives of the present work are to mix sprinkler irrigation with some irrigation methods, furrow and drip irrigation during mid season for cabbage , fertilizing rate and irrigation interval to improve yield and some plant characteristics of cabbage crop in summer season.

1. Applied irrigation water.

Data in Table (7) show that applying irrigation through furrow irrigation (FI), furrow plus sprinkler irrigation (FI +S),drip irrigation(DI) and drip plus sprinkler irrigation (DI+S).Drip irrigation saved about 42% , 43% compared with furrow and furrow plus sprinkler we found the same trend drip plus sprinkler irrigation saved by about 41% and 42 % managed with furrow and furrow plus sprinkler irrigation .Effect of compost on irrigation water data in Table (8) show that by increasing compost from 0.5 ton compost /fed to 1 ton compost/fed. , the irrigation water decreasing by 7.7%. this data may be return to increase the organic matter in the soil, the organic mater witch keep water in the soil so the amount of irrigation water decrease .

Table (7): Average yield and some plant characteristics for different irrigation methods.

Irrigation methods	Mean head weight (kg m)	Mean head diameter (cm)	Mean head height (cm)	Plant height (cm)	Root length (cm)	Fresh root weight	Yield ton/ fed	Irrigation water applied m ³ /fed	WUE kg/ m ³
Furrow irrigation	3.25	35.8	25	45	20	1.8	23.4	4200	5.6
Furrow irrigation + sprinkler	5	40.8	23	48	25	2.0	36	4250	8.6
Drip irrigation.	4.1	35.9	20.5	41.5	21	1.4	29.5	2404	12.3
Drip irrigation +sprinkler	7.25	42.9	25.5	55.5	30	2.4	52.2	2454	21.3

Table (8): Average yield and some characteristics according to fertilizing rate for different irrigation methods.

Fertilizing. treatments	Mean head weight (kg)	Mean head diameter (cm)	Mean head height (cm)	Plant height (cm)	Root length (cm)	Fresh root weight (kg)-	Yield ton/fed	Irrigation water applied m ³ / fed	WUE kg/ m ³
0.5 Ton compost/fed	3.5	38.3	24	44	20	1.9	25.2	2585	9.7
1Ton compost/fed	5.55	40.19	26	51.6	25.5	2.3	39.9	2387	16.7

Yield and some plant characteristics according to deferent irrigation methods.

Some plant characteristics

2.Effect of irrigation methods.

We study effect of irrigation methods on Some plant characteristics such as, mean head diameter (cm) ,mean head height (cm) , plant height (cm) and root length ,the data in fig . (2) show that ,effect applied drip irrigation method compared by furrow irrigation the results were increase mean head diameter (cm) and decrease both mean head height (cm) , plant height (cm)

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and root length (cm) by 21 , 8.4, 5 % respectively this remain to mouthier content was good under drip methods . The data also study effect sprinkler irrigation plus both furrow and drip irrigation .due to using sprinkler plus furrow irrigation increasing by 13 .9 , 8.6 , 6.7, and 25 % compared furrow irrigation for mean head diameter , mean head height , plant height and root length . The increasing in drip plus sprinkler 19.15 , 24.4 , 33.7 ,and 42.8 % compared by drip irrigation .

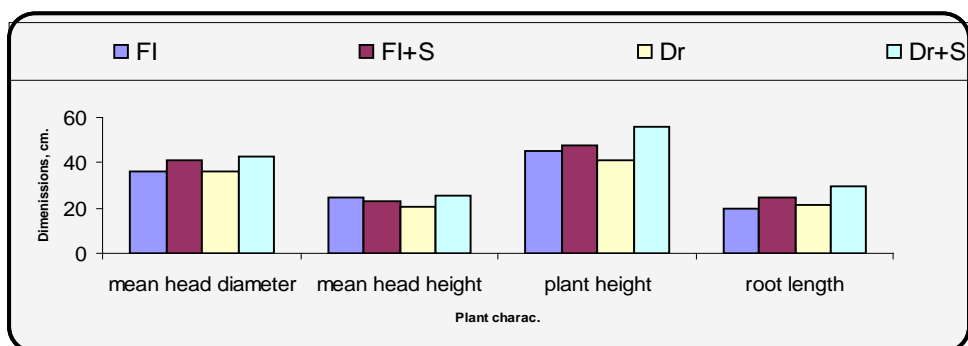


Fig. (2): Effect of irrigation methods on plant characteristics of cabbage yield.

Also in fig (3) show that , effect applied drip irrigation method compared by furrow irrigation on both mean head weight(kg)and fresh root weight (kg),the result show due to drip irrigation increase mean head weight by 26.15 %and decrease fresh root weigh by 28 %compared by furrow irrigation . Due to applied furrow plus sprinkler increase mean head weight (kg) and fresh root weight (kg) by 33.3 and 11.11 %compared furrow irrigation , the same trend with drip plus sprinkler the percentage of increasing 76.8and 71.4 % compared by drip irrigation . this result due to sprinkler irrigation overcome raising of temperature in summer and save moderate climatic.

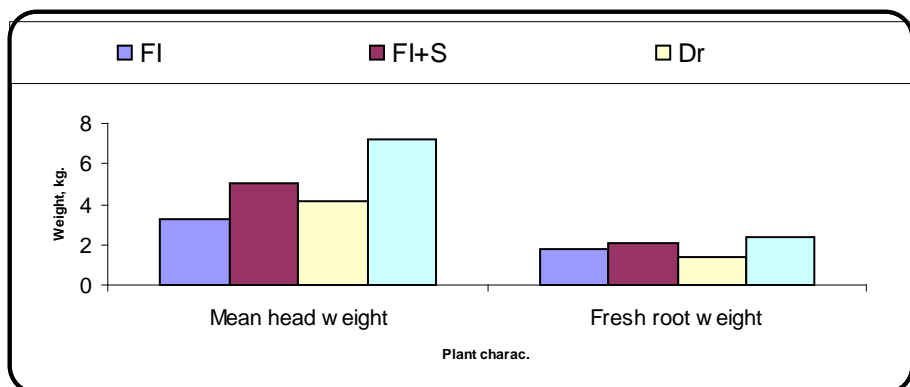


Fig. (3): Effect irrigation methods on plant characteristics of cabbage.

3. Effect of fertilization.

Study effect of fertilization by (0.5 and 1 ton /fed compost) on mean head diameter (cm) ,mean head height (cm) , plant height (cm)and root length. Illustrate in fig. (4) due to use 1 ton /fed compost increase by 4.9, 8.33, 17.3and 27.5 % respectively compared to use 0.5 ton /fed compost .

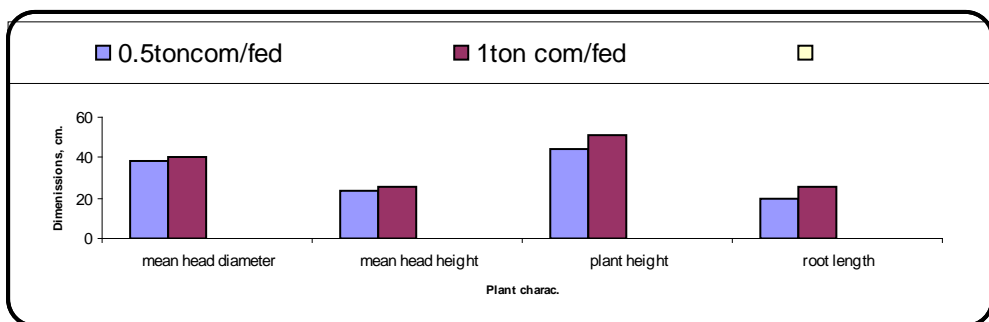
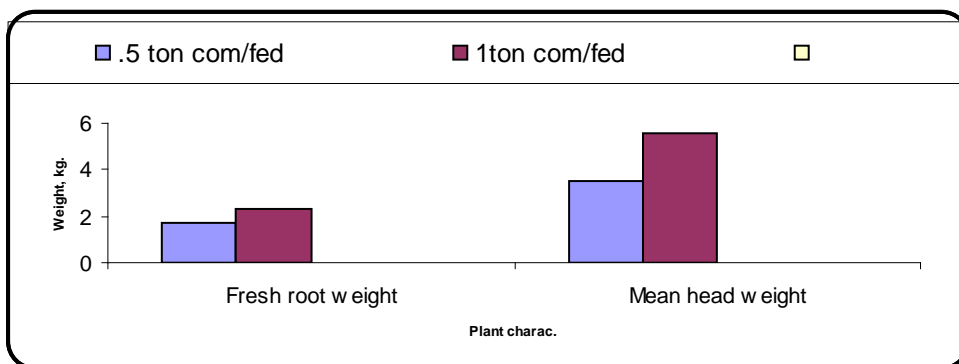


Fig.(4 Effect fertilizing rate from compost on characteristics cabbage yield.

Fig. (5) Show that, by using 1 ton /fed compost increase mean head weight (kg) and fresh root weight (kg) by 58.6 and 21.0% compared by using 0.5 ton /fed . compost .



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Fig. (5): Effect of fertilizing rate of compost on plant characteristics of cabbage.

4. Effect of irrigation interval.

Data in Table (9) illustrate that , effect of interval (daily and three days) of drip and drip plus sprinkler irrigation , data show by using drip irrigation with interval daily increase of on mean head diameter (cm) ,mean head height (cm) , plant height (cm)and root length(cm) , mean head weight (kg) and fresh root weight (kg) by 2.5 , 5.5 15.8, 2.4, 10.0 ,and 25 % respectively compared by drip with interval three days . when using drip plus sprinkler irrigation with interval daily the increasing were 63.6, 12.6 , 0.0 , 1.8 , 3.3 and 10.0 % respectively. these results due to water available to plant directly daily

Table 9

5. Yield (ton/fed).

a-Effect of irrigation methods on yield.

Data in fig. (6) show that , the effect of irrigation method (furrow , drip , furrow plus sprinkler and drip plus sprinkler) on yield ton /fed of cubage crop ..Due to applied sprinkler irrigation increase the yield with both furrow and drip irrigation , the yield increase by 53.8 %in furrow plus sprinkler compared furrow irrigation The increasing in drip plus sprinkler about 77 % compared drip irrigation . the increasing due to applied sprinkler with furrow and drip irrigation because use sprinkler irrigation overcome raising of temperature in summer and save cool climate Witch cabbage crop need in order to improve yield .

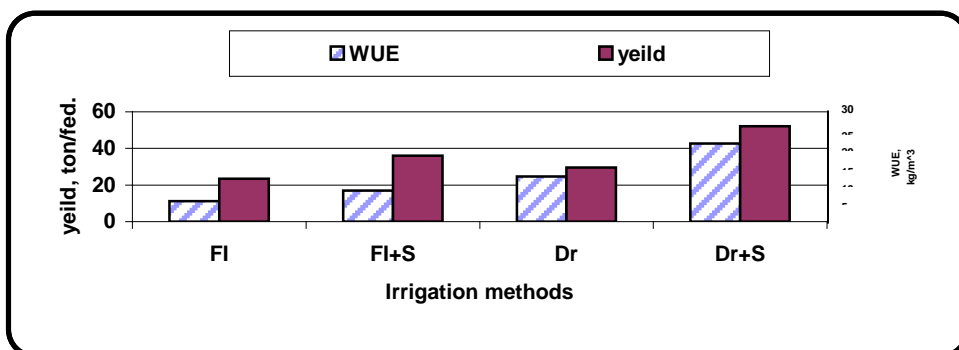


Fig. (6): Yield and water use efficiency under different irrigation methods.

b-Effect of fertilization on yield.

Data in fig. (7) show the effect of fertilization by 1 ton compost / fed increase the yield by 58.3 % comparing by using 0.5 ton compost /fed

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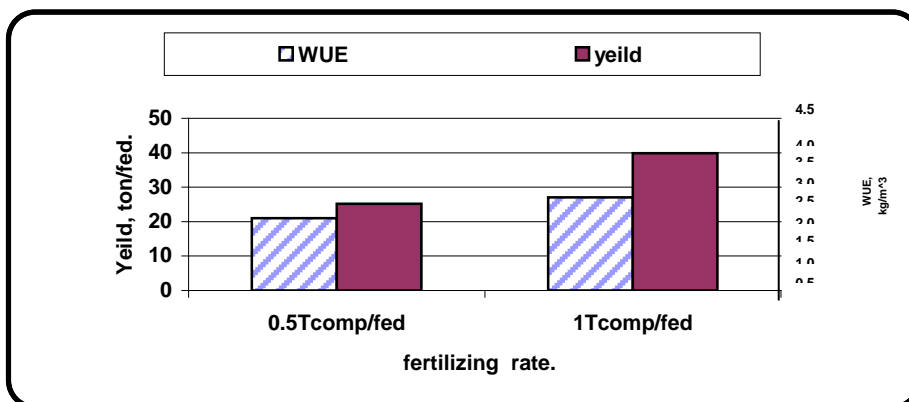


Fig. (7): Effect of fertilizing rate on yield and water use efficiency.

c-Water utilization efficiency(WUE).

The calculated utilization efficiency (WUE) values(kg/m³) as affected by treatment variables the data in fig (6)show that the effect of irrigation systems on water utilization efficiency. the heights value 21.3 kg/m³ under the drip plus(4) sprinkler irrigation flowed by drip irrigation the value 12.3 kg/m³.then the value and furrow plus (4) sprinkler irrigation 8.5kg/m³ and the least value under the furrow irrigation 5.6kg/m³ data in fig.(7)show effect of fertilization by compost and water utilization efficiency the (WUE) increase by increasing the amount of fertilization. The increasing about 72 %under 1 ton compost compared by 0.5 % ton of compost / fed .

d-Effect of irrigation interval(daily , three days)

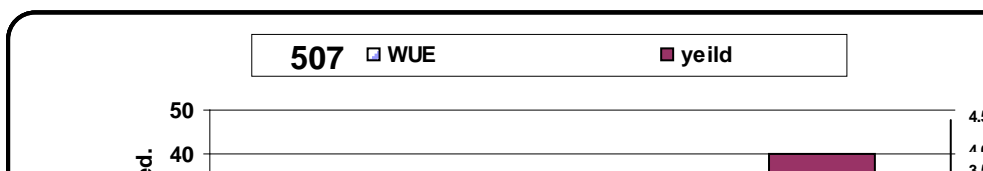
The data in table (9) show that , yield increase by using daily drip irrigation 2.4 %

Compared drip interval three days .Also when applied drip plus sprinkler daily the yield increasing by 63.6 % compared by drip plus sprinkler every three days .

Data in table (9) show that , effect of interval of irrigation (daily , three days) of irrigation on water utilization (WUE) under drip irrigation increasing by 3.4 % compared by drip irrigation three days Also drip plus sprinkler daily irrigation the WUE increase by 64 % compared by drip plus sprinkler three days interval .

Conclusions

The results of this study demonstrate that opportunities exist to improve the performance of furrow and trickle irrigation by max with sprinkler irrigation on cabbage crop in summer season to low raising of temperature and get the highest yield and improved characteristics in Gharbeia region. We recommended by using drip irrigation daily plus sprinkler irrigation with



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fertilizing by ton compost/fed. Data show that the highest increase under drip plus sprinkler for mean head diameter; mean head height; plant height root length (cm); mean head weight ; fresh root weight (kg) 19.15 ; 24.4 ;33.7 ;42.8 ;76.8;and 71.4 %respectively. Compared with drip irrigation the yield increase by 77% in drip plus sprinkler compared with drip irrigation . Effect of fertilizing on yield with using 1 ton compost/fed increase yield by 58.3% comparing with using 0.5 ton compost/fed . Also when applied drip plus sprinkler daily yield increasing with 63.6% compared with drip plus sprinkler every three days .

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دراسة تأثير طرق الري على نمو وأنتاج الكرنب فى الوادى القديم

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المخلص العربى

أجريت هذه الدراسة بمحطة البحوث الزراعية بالجميزة -محافظة الغربية عام ٢٠١٠لدراسة تأثير بعض طرق الري على انتاجية محصول الكرنب ونوعيته مع استخدام التسميد الحيوى. وأظهرت النتائج الأتى:

٦- استخدام الري السطحى مع الري بالرش أدى الى زيادة وزن النبات- قطر النبات- ارتفاع رأس النبات- ارتفاع النبات- طول جذر النبات- وزن جذر النبات- وزن المحصول بمعدل ٩٠,١٣- ٨٠,٦- ٦٠,٧- ٢٥- ٣٣,٣ - ١١,١١ - ٥٣,٨ % على الترتيب مقارنة بالري السطحى.

٧- استخدام الري بالتنقيط مع الري بالرش أدى الى زيادة وزن النبات- قطر النبات- ارتفاع رأس النبات- ارتفاع النبات- طول جذر النبات- وزن جذر النبات- وزن المحصول بمعدل ١٩,١٥ - ٢٤,٤ - ٣٣,٧ - ٤٢,٨ - ٧٦,٨ - ٧١,٤ - ٧٦,٩ على الترتيب عن الري بالتنقيط.

٨- استخدام الري بالتنقيط اليومي أدى الى زيادة وزن النبات- قطر النبات- ارتفاع رأس النبات- ارتفاع النبات- طول جذر النبات- وزن جذر النبات- وزن المحصول بمعدل ٢,٥ - ٥,٥ - ١٥,٨ - ٢,٤ - ١٠ - ٢٥ - ٢,٤ على الترتيب عن الري كل ثلاثة أيام.

٩- استخدام الري بالتنقيط اليومي مع الري بالرش أدى الى زيادة وزن النبات- قطر النبات- ارتفاع رأس النبات- ارتفاع النبات- طول جذر النبات- وزن جذر النبات- وزن المحصول بمعدل ٦٣,٦ - ٦,١٢ - ٠ - ٨,١ - ٣,٣ - ١٠ - ٦٣,٦ على الترتيب عند الري كل ثلاثة أيام.

١٠- التسميد بمعدل ١ طن كومبوست للفدان أدى الى زيادة وزن النبات- قطر النبات- ارتفاع رأس النبات- ارتفاع النبات- طول جذر النبات- وزن جذر النبات- وزن المحصول بمعدل ٤,٩ - ٨,٣٣ - ١٧,٣ - ٢٧,٥ - ٥٨,٦ - ٢١ - ٧١,٣ على الترتيب عن التسميد بمعدل ٠,٥ طن للفدان.

٦- للحصول على أعلى إنتاجية وتحسين مواصفات الإنتاجية لمحصول الكرنب الصيفي تحت ظروف منطقة الجميزة غربية نوصى بتطبيق طريقة الري بالرش في منتصف موسم النمو مع طريقة الري بالتنقيط اليومي الذي يعمل على خفض درجة الحرارة مع التسميد الحيوي بمعدل واحد طن كومبوست للفدان.

Table (9): Yield and some characteristics according to interval for irrigation methods.

Irrigation methods	Interval (day)	Mean head weight (kg)	Mean head diameter (cm)	Mean head height (cm)	Plant height (cm)	Root length (cm)	Fresh root weight (kg)-	Yield ton/fed	Irrigation water applied m³/fed	WUE kg/m³
Drip irrigation	dally	4.1	36.6	22	42	22	1.5	29.5	2404	12.3
Drip irrigation.	3day	4	35.0	19	41	20	1.2	28.8	2404	11.9
Drip irrigation +sprinkler	dally	9	45.5	25	56	31	2.2	64.8	2454	26.4
Drip irrigation +sprinkler	3day	5.5	40.4	25	55	30	2.	39.6	2454	16.1