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IRRIGATION WATER MANAGEMENT AND TILLAGE LEVELS FOR POTATO PRODUCTION UNDER HEAVY SOIL CONDITIONS

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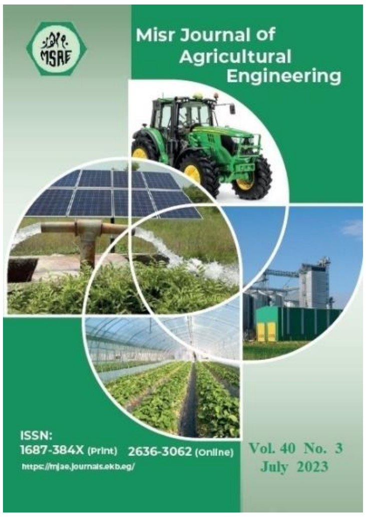

Keywords:

Tillage levels; Deficit irrigation; Potato growth; Yield.

ABSTRACT

The study was carried out at the Experimental Farm of Moshtohor Faculty of Agriculture, Benha University during the winter seasons of 2018 /2019 and 2019/2020 to evaluate the efficiency of surface drip irrigation system for saving water under three irrigation water management strategies (full irrigation requirement (FI) of crop evapotranspiration (ETc) (control), sustainable deficit irrigation (DI) 75 and 50 % of FI,), yield and fruit quality of potato cultivar "Spunta" under different tillage levels (zero, 25, 50 and 100%) tillage depths. The results confirmed that the conversional tillage (100%) (40-50 cm depth) has the best effect on plant growth and yield among all tillage levels. The DI of 75% had the highest growth and yield parameters in both seasons. Respect to the interaction, potato plants that received 75% of ETc under conversional tillage (100%) recorded the highest yield and plant Morphological properties. A gradual increase in tuber yield/fed and water productivity were observed with the increase of tillage degree across all irrigation water levels. The highest tuber yield (17.19 ton/fed) and the highest water productivity (19.34 kg/m^3) for plants that received 75% ETc under the conversional tillage. This means that when utilizing complete ploughing with 75% of the irrigation water requirements, it is possible to conserve around 25% of the irrigation water used while still getting the highest yield.

1. INTRODUCTION

Potato ranks the fourth level after wheat, corn and rice as the most important food crop in the world. Where the cultivated area worldwide in 2022 amounted to about 18.13 million hectares, which gave a production of fresh tubers amounting to 276.12 million tons, while the cultivated area in the same year in Egypt reached 262.9 thousand hectares, and the total production of tubers reached about 6.91 million tons **(FAOSTAT 2021)**. Although the cultivation area and yield have gradually increased in the past 20 years, the continuous population increase and the crop's exposure too many biotic and abiotic stresses caused by climate change caused losses between 18 and 23% of the potato yield in the first three decades of this century. Among all the abiotic factors, shortage of irrigation water is the major limiting factor in potato production and quality **(Jia et al., 2018)**.

There are many irrigation methods used in the production of potatoes, such as conventional furrow irrigation, sprinkler irrigation, surface drip irrigation, and subsurface drip irrigation. Surface drip irrigation is considered one of the most important modern irrigation methods and the most water saving with high yield. The marketable yield of potato tubers increased by 55% and a significant increase in tuber quality, and potato water productivity under drip irrigation compared to conventional furrow irrigation **(Sarker et al., 2019 and Rolbiecki et al., 2021)**. The effect of irrigation water quantity on plant growth were showed before by many authors such as, **Ayas (2013)** who found significant effect of irrigation water level on potato growth. **Gultekin and Ertek (2018)** indicated that water restriction had a significant effect on plant length of potato. Also, **Kiptoo et al. (2018)** found highest plant heights and stems per plant of potato under 100 % ETc. finally, **Barakat et al., (2019)** showed that deep tillage increased significantly number of stems, leaf area and area productivity in m^2 of potato compared to other depths.

Applying 80 to 100% of irrigation requirements helps to achieve high biomass accumulation as suggested by **Camargo et al. (2015)**. Potato growing stage is the least sensitive to water stress. Deficit irrigation strategies aim to expose crops to a certain level of water stress either during a particular growth stage or during the crop-growing season with a non-significant impact on crop yield **(Kirda, 2002)**. Moisture deficit limits of plant productivity, reduces the possibility of realizing the cumulated bio-potential, which cannot be compensated in later plant growth stages. Therefore, soil water resource optimization in order to increase its efficiency in reducing environmental degradation processes, is one of the most important objectives in agriculture (**Nakayama et al., 2007).** Soil tillage may influence on soil properties, especially on soil water content. There was established strong relation between soil tillage, soil compaction, bulk density, aeration and water permeability. Reduced soil tillage increased soil bulk density and compaction and reduced soil aeration and water permeability (**Simanskaitė, 2007**). While, minimum tillage improves soil structure, and crop residues better conserve soil moisture (**Lenssen et al., 2007)** and it is more efficient to use in comparison with intensive tillage. **Nedunchezhiyan et al. (2012)** revealed that the conventional tillage system of sweet potato planting recorded higher sweet potato green fodder yields. **Ji et al., (2013)** found that deep tillage of clay soil at a depth of 30 cm increased the growth of maize and its ability to absorb nutrients and increased its dry mass compared to surface tillage at a depth of (20) cm. In the cold seasons, minimally tilled soil frequently consists of a higher amount of water than intensively tilled. In semi-humid climate conditions intensive soil tillage increased topsoil moisture release into the environment (**Sarauskis et al., 2009)**. Direct seeding in wet years leads to lower and in dry-higher soil moisture content. In no ploughed soil moisture content of the upper layers increased, but it decreased in the deeper layers as compared to conventional tillage (**Feiza et al., 2011)**. **Moraru, and Rusu (2012)** found that soil moisture was higher in no-tillage and medium tillage at the time of sowing and at the early stages of vegetation, then the differences diminished over time. Water dynamics did not show differences that could affect crop yields.

Therefore, this study aims to improve the management of surface drip irrigation system by evaluating the use of deficit irrigation with different tillage levels for potato production to ultimately save water during irrigation also to adjust the expected higher water demand in the event of a future climate change.

2. MATERIALS AND METHODS

Experimental Site

The study was conducted out at the Experimental Farm of Moshtohor Faculty of Agriculture, Benha University, Qalyobia Governorate, Egypt, (30o21'E, 31o13'N; 17 m above sea level) during the winter seasons of 2018/2019 and 2019/2020 to evaluate the efficiency of some irrigation water management strategies (100, 75 and 50 % ETc) on growth, yield and fruit quality potato cultivar *Spunta* under different tillage levels (zero, 25, 50 and 100%) by using irrigation network facilities and measuring devices belong to a the project "Water Saving in Agriculture: technological developments for the sustainable management of limited water resources in the Mediterranean area" funded by " Academy of scientific Research and Technology, ASRT", Egypt. The region is characterized by arid with total 22 mm rainfall and medium temperature, humidity and evaporation.

Soil Physical and Hydro-Physical Properties

The soil sample was air dried ground and sieved to pass through 2 mm sieve then subjected to some physical and hydro-physical analysis whose results are presented in Table (1).

Table 1: The experimental soil physical and hydro-physical properties as the average of two seasons of the study.

Physical Soil Analysis				
Particle size distribution			Textural class	Bulk Density gm/cm^3
Sand %	Silt %	Clay %		
8.57	49.57	41.86	Clay	1.25
Soil Moisture content				
Field Capacity %	Welting Point %	Available Water %	Saturation Point %	
37.35	17.8	19.55	62.5	

Experimental Layout and Design

The field experiment was carried out as a split plot system of three replications to evaluate the effect of the degree of tillage and irrigation level on the growth, yield and quality of the potato crop. Where, the tillage level (100%, 50%, 25% and zero tillage) were allocated in the main plots while irrigation treatments (100, 75 and 50% of ETc were distributed in the sub-plots). For this purpose, the experimental field was divided into four main parts for distribute the four tillage used as shown in Fig. (1).

Drip Irrigation System components

A Centrifugal pump was used (type E5300) with operating pressure head ranged between 13.5-32 m and corresponding discharge rates ranged from 500-100 l/min. The pump connected directly by an electric motor of 2.25 kW power. The main line was of 63 mm diameter PVC pipe, and the sub- main was 25.4 mm PVC pipe. PE lateral line with built in drippers were used (13.1 mm inner diameter with built in 4 L/h emitters of average flow rates at 1 bar operating pressure and spaced 50 cm apart)

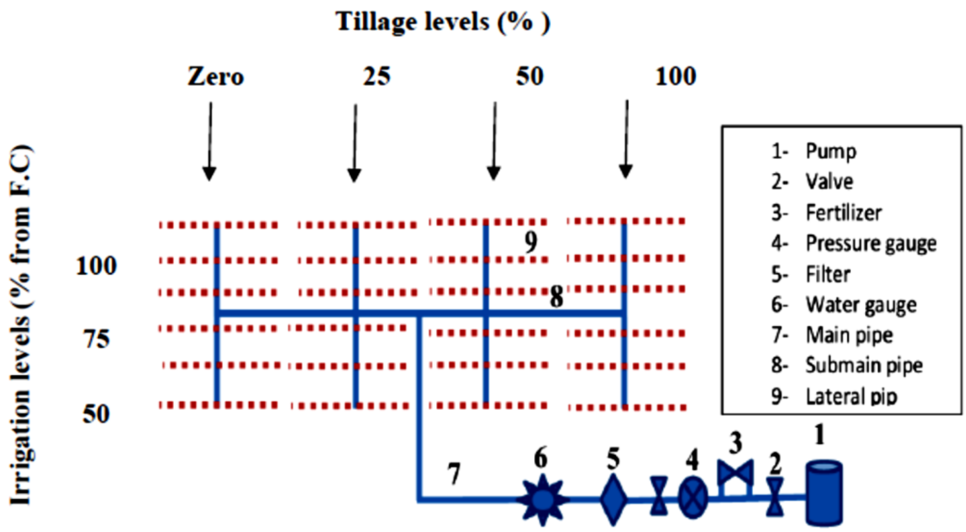

Fig (1): planning of irrigation network.

Tillage Treatments

The treatments of tillage were:

A. Conversional tillage (100%): were done using moldboard plowing at 40-50 cm, followed by one rotary hoeing at 10-20 cm.

B. Medium tillage (50 % Conversional tillage): were done using moldboard plowing at 20-25 cm, followed by one rotary hoeing at 5-10 cm

C. Minimum tillage (25 % Conversional tillage): were done using a chiseling at 10 cm depth followed by one rotary hoeing at 5-10 cm.

D. No-tillage: In no-tillage levels potato tubers were direct sowing in the row, hand tilling (5 cm deep) was performed before potato sowing.

In all tillage levels a four-by-four tractor with a power of 120 kW was used with the plowing being done twice perpendicularly.

Field Crop under Study

Potato tubers "*Solanum tuberosum*، Spunta cultivar" was obtained from Horticulture Department of Agricultural Research Center. The tuber used in planting were uniform in shape and free from physiological and disease infection. All agricultural practices were carried out, including the application of herbicide, fertilization rates, and hoeing, according to the technical recommendations for the crop issued by the Egyptian Ministry of Agriculture and Land Reclamation.

In both planting seasons (2018-2019 and 2019-2020), the tillage process was carried out at the beginning of October, then the soil was left for ventilation. The site was divided into four plots where the main plots were divided into 9 equal plots. Each plot is 9.1 m^2 (13 m x 0.7 m), and the three irrigation treatments were distributed in three replicates under each tillage level. Potato was planted at 50 cm spacing in the form of whole tubers in the last week of October.

The land was irrigated under the drip irrigation system on the next day of cultivation directly until reached to the field capacity and the degree of soil fermentation required for tuber germination.

Water management treatments

Water consumptive use (mm/day) was calculated according to the climate data obtained from local weather station data, which located in Moshtohor and affiliated to the Central Laboratory for Agricultural Climate (CLAC) Ministry of Agriculture and Land Reclamation using the **Penman-Monteith** method**.** Three water regimes were applied for irrigate potato crop i.e. irrigation at 100, 75 and 50 % ETc. Irrigation treatments were practiced after the complete germination of the tubers, three weeks from sowing, and irrigation was withheld before the harvest by about 10-15 days. The irrigation process was every five days. The deficit irrigation treatments were applied as the percentages from ETc in the field capacity.

Measurements and Calculations

1. Soil moisture

Soil moisture meter (HH2 with WET-2 sensor model, Delta-T, Cambridge, England) was used to monitor the daily soil moisture content and monitor changes in soil moisture after irrigation till the next throughout the season from perpendicular to the lateral line, at 0, 15 and 30 cm from the emission point throughout the root zone at depths of 0 to 20, 20 to 40 and 40 to 60 cm after irrigation for different irrigation treatments.

2. Growth parameters

Fifteen plants were randomly selected from each treatment at 80 and 110 days after planting to measure number of branches/plant, number of leaves/plant, leaf content of total chlorophyll, Foliage fresh weight (g) and foliage dry weight (g). At the end of each season, mean of 15 plants were taken in each treatment at harvesting to measure number of tuber/plant, average tuber weight (g), tuber length (cm), tuber diameter (cm), tuber thickness (cm), and tubers yield/pant (kg).

3. Water Productivity (WP):

Water productivity, is the total weight of tubers (kg) that produced from consumed one m^3 of water, which estimated according to **Vites (1965)** as follow:

$$\boldsymbol{WP} = \frac{Tubers\ yield\ per\ feddan\ (kg)}{Total\ consumed\ water\ (m^3) per\ fed}$$

Statistical Analysis

Results were expressed as mean. The data were analyzed by using Two-way ANOVA followed by LSD test through SPSS 16 (version 4). The treatments means were compared using least significant difference (LSD) tested at significant levels of 5% as described by **Gomez and Gomez (1984)**.

3. RESULTS AND DISCUSSION

1. **Effect of tillage levels, deficit irrigation levels and their interaction on potato growth during two seasons**

The obtained results in Table (2) cleared that plant height, number of branches/plant, number of leaves/plant, leaf content of total chlorophyll, foliage fresh weight and foliage dry weight gradually increase with the increase of tillage levels in both seasons as an average for all irrigation levels. Potato plants under conversional tillage (100%) recorded the highest plant height (106.75 cm), branches number/plant (7.57), leaves number/plant (32.62), leaves content of total chlorophyll (57.85), foliage fresh weight (295.8 g) and foliage dry weight (53.78 g) in both seasons. On the other side, the lowest values were observed und zero tillage in both seasons. **Ayas (2013), Gultekin and Ertek (2018)**, **Kiptoo et al. (2018)** and **Barakat et al., (2019)** showed that deep tillage increased significantly number of stems, leaf area and area productivity in m^2 of potato compared to other depths.

For the irrigation levels, Potato plants that received 75% ETc had the highest plant height (99.24 cm), branches number/plant (7.02), leaves number/plant (31.84), leaves content of total chlorophyll (58.05), foliage fresh weight (284.31 g) and foliage dry weight (51.70 g) in both seasons. In the contrast of this potato plant that received the full irrigation water (100%) recorded the lowest values both seasons. These results in the same trend with **Nedunchezhiyan et al. (2012)** and **Ji et al., (2013).**

Regarding to the effect of tillage levels and irrigation deficit levels interaction on growth traits of potato plants the results in Table (2) revealed that potato plants differ in their response to irrigation deficit water according to tillage levels in both seasons. Potato plants that received 75% ETc under the conversional tillage (100% tillage) had the highest plant height (128.94 cm), branches number/plant (9.5), leaves number/plant (38.05), leaves content of total chlorophyll (65.3), foliage fresh weight (346.67 g/plant) and foliage dry weight (63.03 g) as an average of two seasons. On the other hand the lowest plant height was observed in potato plants that received 50% ETc with zero tillage.

2. **Effect of tillage levels, deficit irrigation levels and their interaction on potato tuber yield and yield components during two seasons**

The obtained results in Table (3) cleared that tubers number/plant, tuber weight, tuber length, tuber diameter, tuber thickness and tuber yield/plant gradually increase with the increase of tillage levels in both seasons. Potato plants under conversional tillage (100%) recorded the highest tubers number/plant (10.63), tuber weight (115.7 g), tuber length (8.9 cm), tuber diameter (7.25 cm), tuber thickness (6.37 cm) and tuber yield/plant (1.2 kg) in the two seasons. On the other side the lowest values were observed und zero tillage treatment in both two seasons. Respect to the effect of deficit irrigation levels, potato plants that received 75% ETc had the highest tubers number/plant (9.84), tuber weight (106.38 g), tuber length (8.87 cm), tuber diameter (7.07 cm), tuber thickness (6.23 cm) and tuber yield/plant (1.034 kg). In the contrast of this potato plant that received the full irrigation water (100%) recorded the lowest values in the two seasons.

The results indicated that potato plants that received 75% ETc under the conversional tillage (100% tillage) had the highest tubers number/plant (12.73), tuber weight (140.88 g), tuber length (8.75 cm), tuber diameter (8.49 cm), tuber thickness (7.47 cm) and tuber yield/plant (1.72 kg). On the other hand the lowest values were observed in potato plants that received 50% ETc with zero tillage in two seasons. similar results were discussed by **Onder et al., (2005)** and **Ferreira and Goncalves (2007)** who reported that water deficiency of less than 33% did not result in a decrease in potato tuber yield but significantly increased water use efficiency.

Table 2: Effect tillage levels, deficit irrigation levels and their interaction on potato growth during both seasons.

Factors		Plant height (cm)		Number of branches/plant		Number of eaves/plant		leaf content of total chlorophyll (mg/100 g fw)		Foliage fresh weight (g)		Foliage dry weight (g)	
		1st season	2nd Season	1st season	2nd Season	1st season	2nd season	1st Season	2nd season	1st season	2nd season	1st season	2nd Season
Tillage levels													
Zero		64.98 d	68.99 d	4.22 d	4.68 d	23.66 d	24.60 d	45.27 d	49.41 d	207.92 d	207.87 d	37.80 d	37.80 d
25%		72.80 c	77.28 c	4.77 c	5.28 c	25.52 c	26.55 c	47.88 c	52.16 c	230.64 c	231.49 c	41.94 c	42.09 c
50%		85.95 b	91.24 b	5.89 b	6.52 b	28.53 b	29.75 b	53.51 b	58.38 b	253.74 b	256.78 b	46.13 b	46.69 b
100%		103.59 a	109.92 a	7.21 a	7.93 a	31.88 a	33.36 a	55.53 a	60.18 a	292.84 a	298.75 a	53.24 a	54.32 a
LSD 5%		**5.63**	**5.97**	**0.44**	**0.48**	**1.20**	**1.28**	**1.59**	**1.70**	**12.08**	**12.96**	**2.20**	**2.36**
Irrigation levels													
100% FC		69.92 c	74.25 c	4.58 c	5.07 c	24.73 c	25.75 c	47.10 c	51.37 c	222.81 c	223.64 c	40.51 c	40.66 c
75% FC		96.30 a	102.17 a	6.68 a	7.36 a	31.17 a	32.51 a	55.65 a	60.45 a	282.52 a	286.10 a	51.37 a	52.02 a
50% FC		79.27 b	84.16 b	5.31 b	5.87 b	26.30 b	27.43 b	48.89 b	53.28 b	233.52 b	236.43 b	42.46 b	42.99 b
LSD 5%		**5.35**	**5.66**	**0.43**	**0.47**	**1.34**	**1.41**	**1.80**	**1.91**	**12.73**	**13.20**	**2.32**	**2.40**
Tillage levels	**Irrigation levels**												
Zero	**100% FC**	52.10	55.38	3.25	3.62	20.38	21.16	40.85	44.50	179.72	178.45	32.68	32.45
	75% FC	78.71	83.58	5.22	5.79	28.00	29.13	51.22	55.92	252.39	252.66	45.89	45.94
	50% FC	64.11	68.02	4.18	4.63	22.61	23.50	43.76	47.82	191.64	192.51	34.84	35.00
25%	**100% FC**	62.46	66.32	4.02	4.47	23.42	24.36	46.00	50.42	210.07	210.47	38.19	38.27
	75% FC	86.39	91.66	5.82	6.41	28.59	29.77	51.77	55.99	258.04	259.47	46.92	47.18
	50% FC	69.54	73.87	4.48	4.97	24.55	25.53	45.89	50.07	223.83	224.55	40.70	40.83
50%	**100% FC**	78.10	82.93	5.24	5.80	26.81	27.90	50.89	55.46	239.81	241.37	43.60	43.88
	75% FC	94.91	100.74	6.61	7.32	30.91	32.24	56.76	62.18	276.79	281.79	50.32	51.24
	50% FC	84.82	90.06	5.83	6.44	27.87	29.10	52.87	57.52	244.62	247.19	44.48	44.94
100%	**100% FC**	87.03	92.35	5.81	6.41	28.28	29.56	50.69	55.12	261.64	264.30	47.57	48.05
	75% FC	125.17	132.71	9.06	9.94	37.18	38.91	62.86	67.72	342.86	350.48	62.34	63.72
	50% FC	98.59	104.70	6.75	7.44	30.18	31.61	53.04	57.71	274.02	281.48	49.82	51.18
LSD 5%		**9.09**	**9.63**	**0.72**	**0.79**	**2.28**	**2.39**	**3.07**	**3.26**	**21.65**	**22.44**	**3.94**	**4.08**

Table 3: Effect tillage levels, deficit irrigation levels and their interaction on potato tuber yield and yield components during both seasons.

Factors		Number of tubers/plant		Tuber weight (g)		Tuber length (cm)		Tuber diameter (cm)		Tuber thickness (cm)		Tuber yield/plant (g)	
		1st season	2nd Season	1st season	2nd Season	1st season	2nd Season	1st season	2nd Season	1st season	2nd Season	1st season	2nd Season
Tillage levels													
Zero		6.41 d	6.84 d	67.65 d	71.84 d	6.75 b	7.33 b	5.21 d	5.42 d	4.59 d	4.77 d	424.42 d	481.47 d
25%		7.26 c	7.75 c	76.52 c	81.25 c	7.13 b	7.73 b	5.64 c	5.87 c	4.96 c	5.16 c	539.50 c	610.79 c
50%		8.58 b	9.18 b	91.33 b	96.94 b	8.05 a	8.72 a	6.32 b	6.59 b	5.56 b	5.80 b	751.51 b	852.77 b
100%		10.29 a	10.97 a	112.27 a	119.13 a	8.56 a	9.24 a	7.09 a	7.42 a	6.24 a	6.53 a	1129.03 a	1275.37 a
LSD 5%		0.38	0.43	5.12	5.00	0.66	0.70	0.34	0.33	0.22	0.29	103.06	109.67
Irrigation levels													
100% FC		7.00 c	7.47 c	73.28 c	77.82 c	6.96 c	7.56 c	5.46 c	5.68 c	4.80 c	5.00 c	508.45 c	576.22 c
75% FC		9.52 a	10.15 a	103.22 a	109.53 a	8.53 a	9.22 a	6.92 a	7.22 a	6.09 a	6.36 a	971.38 a	1097.52 a
50% FC		7.89 b	8.43 b	84.32 b	89.52 b	7.38 b	8.00 b	5.82 b	6.07 b	5.12 b	5.34 b	653.52 b	741.57 b
LSD 5%		0.28	0.32	3.52	3.58	0.33	0.36	0.25	0.25	0.30	0.22	63.62	68.81
Tillage levels	**Irrigation levels**												
Zero	**100% FC**	5.20	5.54	53.16	56.53	5.90	6.43	4.46	4.64	3.93	4.08	263.50	299.60
	75% FC	7.72	8.24	82.63	87.76	7.75	8.42	6.20	6.45	5.46	5.68	606.09	687.39
	50% FC	6.30	6.74	67.16	71.24	6.59	7.15	4.97	5.17	4.38	4.55	403.68	457.43
25%	**100% FC**	6.26	6.70	64.44	68.42	6.70	7.28	5.16	5.36	4.54	4.72	383.55	435.76
	75% FC	8.56	9.10	92.11	97.77	7.88	8.52	6.34	6.61	5.58	5.81	750.25	845.75
	50% FC	6.96	7.44	73.01	77.57	6.81	7.39	5.42	5.64	4.77	4.96	484.69	550.88
50%	**100% FC**	7.82	8.36	82.36	87.45	7.58	8.22	5.93	6.18	5.22	5.43	613.40	696.43
	75% FC	9.44	10.14	101.39	107.56	8.62	9.32	6.86	7.15	6.04	6.30	911.81	1036.87
	50% FC	8.48	9.04	90.24	95.81	7.96	8.62	6.17	6.44	5.43	5.67	729.31	825.01
100%	**100% FC**	8.72	9.28	93.16	98.88	7.67	8.30	6.28	6.55	5.52	5.77	773.34	873.11
	75% FC	12.34	13.12	136.76	145.01	9.85	10.60	8.29	8.69	7.30	7.64	1617.38	1820.06
	50% FC	9.80	10.50	106.89	113.48	8.18	8.82	6.70	7.02	5.90	6.18	996.38	1132.94
LSD 5%		0.47	0.54	5.86	5.97	0.56	0.61	0.41	0.42	0.36	0.37	106.01	114.66

3. Tuber yield and water productivity across the two seasons.

The data in Table (4) confirmed that tuber yield/fed and water productivity differ according to irrigation levels and tillage degrees. A gradually increase in tuber yield/fed and water productivity were observed with the increase of tillage degree across all irrigation water levels. Potato plants that received 75% of ETc under the conversional tillage had the highest tuber yield/fed (17.19 tons) and the highest water productivity (19.34 kg/m^3) followed by plants that received 50% ETc under conversional tillage with averages of 10.65 tons/fed and 16.09 kg/m^3. On the other side, potato plants that received 100% ETc under zero-tillage recorded the lowest tuber yield/fed (2.82 tons) and the highest water productivity (2.54 kg/m^3) when compared with all irrigation levels under all tillage levels.

Table 4: Effect of tillage and irrigation techniques on yield and water productivity (WP).

Parameters	**Irrigation levels**	**Applied water (m^3/fed)**	**Tillage levels**			
			100%	**50%**	**25%**	**0**
Yield (ton/fed)	**100%**	1098.8	8.23	6.55	4.10	2.82
	75%	888.8	17.19	9.74	4.98	6.47
	50%	661.9	10.65	7.77	5.18	4.31
WP (kg/m^3)	**100%**	1098.8	7.49	5.88	3.68	2.54
	75%	888.8	19.34	10.96	5.60	7.28
	50%	661.9	16.09	11.75	7.83	6.52

Our results are in the same line with those of **Crosby and Wang (2021)** and **Hassan (2022)** who found that the deficit irrigation at 75% ETc or even 50% ETc during the late season had no impact on tuber growth.

4. CONCLUSSION

Water is considered one of the most important factors affecting the growth and development of potato tubers, as water represents about 79% of the weight of tubers. Therefore, the lack of water in the tuber growth stage will lead to a decrease in tubers volume and weight, which will have a negative impact on the final yield. The results confirmed that potato plants under 100% tillage levels recorded the highest plant growth and yield traits. For irrigation levels, potato plants that received 75% ETc had the highest growth and yield parameters in both seasons. Respect to the interaction between irrigation and tillage treatments, potato plants that received 75% ETc under conversional tillage (100%) recorded the highest growth parameters, number of tubers/plant, average tuber weight, tuber dimensions and tuber yield/plant. A gradually increase in tuber yield/fed and water productivity were observed with the increase of tillage degree across all irrigation water levels. The highest tuber yield (17.19 ton/fed) and the highest water productivity (19.34 kg/m^3) for plants that received 75% ETc under the conversional tillage.

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إدارة مياه الري ومستويات الحراثه لإنتاج البطاطس في ظروف التربة الثقيلة

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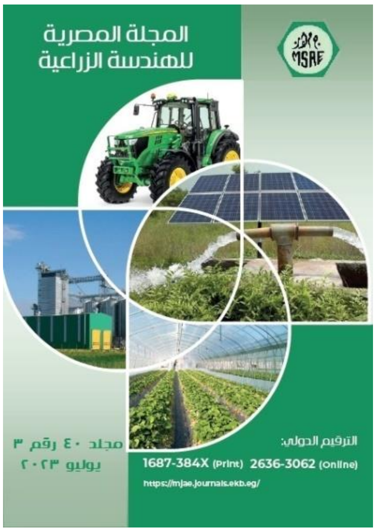

الكلمات المفتاحية:
مستويات الحراثه؛ الرى المحدود؛ نمو وانتاجية البطاطس.

الملخص العربى

أجريت هذه الدراسة في المزرعة البحثية لكلية الزراعة بمشتهر بجامعة بنها خلال موسمى النمو ٢٠١٩/٢٠١٨ و ٢٠٢٠/٢٠١٩ لتقييم كفاءة بعض تقنيات توفير مياه الري (٧٥% و ٥٠٪ من الاحتياج المائى) مقارنة بالرى بكامل الاحتياجات المائيه (١٠٠%) باستخدام نظام الرى بالتنقيط على النمو ومحصول الدرنات لصنف البطاطس سبونتا تحت مستويات حراثة مختلفة (صفر ، ٢٥ ، ٥٠ و ١٠٠٪) بالنسبة لعمق الحراثة التقليديه (٤٠-٥٠ سم عمق). أكدت النتائج أن الحراثة التقليدية (١٠٠٪) كانت الأفضل بين جميع مستويات الحراثة حيث سجلت نباتات البطاطس تحت مستويات الحراثة ١٠٠٪ أعلى صفات نمو وإنتاجية. بالنسبة لمستويات الري ، فإن نباتات البطاطس التي استقبلت ٧٥٪ من مياه الاحتياجات المائية كان لها أعلى مؤشرات نمو وإنتاجية في كلا الموسمين .فيما يتعلق بالتأثير المشترك، سجلت نباتات البطاطس التي حصلت على ٧٥ ٪ من الاحتياجات المائيه تحت الحراثة التقليدية أعلى إنتاج في محصول الدرنات/نبات وكذلك الصفات المورفولوجية للنبات. لوحظت زيادة تدريجية في محصول الدرنات/فدان والإنتاجية المائيه مع زيادة درجة الحراثة خلال جميع مستويات مياه الري. أعلى إنتاجية من الدرنات كانت ١٧,١٩ طن/ فدان وأعلى إنتاجية للمياه (١٩,٣٤ كجم / م^{3}) للنباتات التي حصلت على ٧٥٪ من الاحتياجات المائيه تحت الحراثة الكامله. لهذا يمكن القول بأنه يمكن توفير حوالى ٢٥% من مياه الرى المستخدمة مع الحصول على أعلى إنتاجيه عند استخدام الحراثة الكاملة مع الرى بـ ٧٥% من الاحتياجات المائيه.