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OPTIMIZING POTATO PRODUCTION WITH HYDROGEL TREATMENT AND IRRIGATION MANAGEMENT

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ABSTRACT

Increasing global food demand due to increasing populations led to an increase in water requirements.

The limited water resources and insufficient water supply for consumer for irrigation are important facing Egypt (governorate, researchers, and farmers).

Water deficiency is a main environmental constraint that jeopardizes production of the crops in the world. Egypt ranks 107 of 181 countries of the world concerning.

This study investigated the effect of irrigation regimes (IR) irrigation every 10 days and irrigation every 20 days and treating clay soil with three concentrations (HG=0.0, HG=2.5 and HG=5.0 per fed.) as a soil additive on plant growth, water use efficiency, productivity, and tuber quality of potato plant c.v. Lady Balfour. The experiment was conducted at the experimental farm of the Horticulture Department at Minia University's Faculty of Agriculture over two consecutive fall seasons (2018/2019 and 2019/2020). Soil analysis was performed, and the experiment was set up in split plots using a complete randomized block design with four replications (IR in the main plot and HG treatments in sub plot).

The experiment demonstrated that irrigation regime had a significant effect on plant growth parameters i.e., plant height, plant fresh and dry weights.

The first regime (irrigation every 10 days) shows the highest values of plant growth compared to the second regime. Hydrogel treatment also had a

significant effect on plant growth. The highest concentration showing the best effect in improving plant height. Irrigation intervals treatment also had a significant effect on growth, yield, and its components in both seasons.

In conclusion, the study found that irrigation regime and hydrogel treatment had significant effects on various growth parameters of potato plants. The first irrigation regime (irrigation every 10 days) and hydrogel treatment at its highest concentration showed the best results in improving plant growth, water use efficiency, productivity, and tuber quality addition to its effect to improve the adverse effects of water shortage effect with the second irrigation regime.

Keywords: Potato, Hydrogel, Irrigation, Water use efficiency, Productivity

INTRODUCTION

Potatoes are a significant solanaceous vegetable in Egypt, grown for both local consumption and export.

The water deficiency in many regions of the world becomes a serious problem in arid and semi-arid lands (Vundavalli et al.,2014 and Chang et al.,2021). Geoparadize club productivity resulting from factors i.e, human activities climate change and others (Naeem et al.,2018). Increasing the incidence of drought stress by climate change leading yield reductions (Khodadai.,2016).

Potato crop globally after rice and wheat and import Moveant in developed and developing countries (Luteledio and Casteldi.,2009) , Sensitive to drought stress leading to loss of yield (Nesir and Toth.2022). Therefore, the potato crop needs to optimum rate of water to obtain its yield.

Using hydrogel (cross-linked polymers with hydrophilic groups have the ability to absorb water without dissolving in it (Schacht.,2004), provides solutions to several problems in agriculture (Abd El-Aziz et al., 2022) can be used to promote yield, growth of crops irrigated with contaminated waste water (Dhiman et al .,2021).

Mini researchers around the world (USA, Canada, India, Italy, Iran, Poland, Turkey, and others) studied hydrogel and stated that hydrogel retains soil moisture well and mineral nutrition in its and reduced nutration when added to the soil.(Hou et al.,2018 and Starovoit et al.,2019) increase water holding capacity (Ibrahim et al.,2015).

Also, (Jhurry ,1997) mentioned that crosslinked polyacrylamide holds 400 times their weight in water and retain 95 % of the water within the granule to plant growing. Thus, there is an urgent need for water management through water use efficiency and water saving in the agriculture sector. Therefore, the objective of this study was to stress tow system for irrigation regimes and pre-planting soil additives with hydrogel on potato cv. Lady Balfour yield and quality as well as measuring the water use efficancy.

To achieve high yields, the crop water requirements (ETm) for a 120-to-150-day crop range from 500 to 700 mm.

The relationship between maximum evapotranspiration (ETm) and reference evapotranspiration (ETo) is given by the crop coefficient (kc) (Tilaye et al., 2020). Under conditions of limited water supply, the available supply should preferably be directed towards maximizing yield per fed. rather than spreading the limited water over a larger area. Savings in water can be made through improved timing and depth of irrigation application (Marazky et al, 2019).

Dry matter content may increase slightly with limited water supply during the ripening period. Frequent irrigation reduces the occurrence of tuber malformation (Nasir and Toth 2022).

Good yields under irrigation of a crop of about 120 days in temperate and subtropical climates are 12 to 15 ton/fed fresh tubers and in tropical climates yields are 15 to 25 ton/ha. The water utilization efficiency for harvested yield (Ey) for tubers containing 70 to 75 percent moisture is 4 to 7 kg/m^3 (Haverkort and Struik 2015).

Hydrogels are polymer networks extensively swollen with water. They are hydrophilic gels that are networks of polymer chains that can absorb water due to hydrophilic functional groups attached to the polymeric backbone. Their resistance to dissolution arises from cross-links between network chains. (Nasrullah.,2010)

Many materials, both naturally occurring and synthetic, fit the definition of hydrogels.

During the last two decades, natural Hydrogels were gradually replaced by synthetic hydrogels which have long service life, high capacity for water absorption, and high gel strength. Synthetic polymers usually have well-defined structures that can be modified to yield tailor-able degradability and functionality. Hydrogels can be synthesized from purely synthetic components and are stable under conditions of sharp and strong fluctuations of temperatures.

The aim of this study was to assess the effect of using pre-planting soil additive with hydrogel and irrigation regimes of potato cv. Lady Balfour incasement plant growth, yield , quality and water use efficiency.

MATERIALS AND METHODS

This experiment was conducted at the experimental farm of the Horticulture Department at Minia University's Faculty of Agriculture. The physical and chemical properties of the soil are shown in (Table 1).

The experiment was carried out over two consecutive Fall seasons (2018/2019 and 2019/2020) to investigate the effect of irrigation regimes (IR) with two intervals (irrigation every10 days and irrigation every 20 days) and soil additive hydrogel (HG) with three concentrations (H.G=0.0, H.G=2.5k.g/fed and H.G=5.0k.g/fed) as a soil additive during land preparation at soil depth of 12-15 cm inside the planting ridges as described by (Kalhpure et al.,2016) who showed that the rate of application of hydrogel depends on the soil texture (2.5 – 5.0 k.g /hectar) at the soil depth of 6-8 inches (Kalhpure et al.,2016) .

Soil analysis was performed according to the method of (Piper 1974). The electrical conductivity (EC) of soil was determined in a soil-water extract using a conductivity meter as described

by (Hesse 1972). Total nitrogen was determined using Micro Kjeldahl's method (1883). Available phosphorus and potassium was determined according to Olson's method as described by Rathje (1959b).

Plant material: -

Potato cv. Lady Balfour was used in this trial and the potato seeds was purchased from a potato storage refrigerator at the end of August and were kept at room temperature till planting. Some characters of these cultivars were shown in **Table 2**

Land preparation: -

The soil was ploughed twice in two opposite directions and plots were planned and divided. The recommended fertilizers were add .The experimental plot consisted of five ridges, each 4 meters long and 0.7 meters wide, forming a plot area of 14 m^2 equal to (1/300 fed)and the pre-irrigation was done.

Planting:-

When the soil moisture reached to 70 to 80 field capacity, the soil was ready for planting. For the first and second seasons the hydrogel treatment were added as mentioned above, selected tubers were planted manually on September 5 and 7, respectively. The distance between hills inside ridges was around 25 cm, with depths of 12 cm on the east side of the ridges. The treatments of irrigation regimes (IR) after the germination complete (four weeks from planting) were distributed in the main plots while hydrogel (HG) concentrations were calculated for each experimental plot and was distributed in the subplots. The experiment was then set up in split plots using a complete randomized block design with four replications.

Treatments: -

The treatments were add to the soil before planting and arranged as follow:-

1- IR every 10 days (A1)
2- IR every 20 days (A2)
3- HG= 0.0
4- HG=2.5 kg/fed
5- HG=5.0 kg/fed
6- IR every 10 days+ HG 2.5 kg/fed
7- IR every 10 days+ HG 5.0 kg/fed
8- IR every 20 days+ HG 2.5 kg/fed
9- IR every 20 days+ HG 5.0 kg/fed

After 85 days from sowing, five plants from each experimental plot were chosen randomly and the following characteristics were measured for the

The following characteristics were measured for the evaluation process.

I. Plant height (cm): The longest stem of each plant was measured from plant base to its top.
II. Plant fresh weight of vine gm/ plant.
III. Plant dry weight of vine gm/ plant which was calculated from drying the whole plant vegetative portion plant stem and leaves at 65-70℃ till the constant weight.
IV. Potassium % of leaves, the third leaf at the top and bottom of the main plant were taken for each sample and oven dried at 65-70℃ until a constant weight, and then 0.2 gm of the dried leaves was taken for chemical analysis to determine potassium percentage in plant tissue. where Potassium was measured using the flame photometer device according to (Rathje 1959b).
V. Yield and its components:

Five plants in each plot were harvested (112 days from planting at maturity

stage and the following data were recorded:

- Total tuber weight per plant: Potato tubers were collected and graded according to their diameter 1 small (25-5 cm). medium (5.0-6.5 cm) and large (>6.5 cm tubers) using wire-mesh-riddles differing in size as reported by Adams and Hide (1981), then number and weight (kg) of small, medium, and large tubers per plant were determined, weighted, and divided as follow:
  a. Number and weight of large tubers/ plant
  b. Number and weight of medium tubers/ plant
  c. Number and weight of small tubers/ plant

VI. Total yield as (ton/fed): was determined as a yield of each plot then calculated as ton/fed.

VII. Tubers Quality

VIII. Tuber dry matter %: Dry matter percentage of tubers were determined by using 100 gm of tubers dried at 24℃ until a constant weight. According to (Association of Official Analytical and Helrich 1990).

IX. Specific gravity of tubers: Tuber weight in air vs. tuber weight in water as reported by (Sinha et al. 2003).

X. Water Measurements: The quantity of water was measured in studied area by cutthroat Flume size (20×90 cm) where applied water was added during each irrigation and at the end of each growth season the total quantity of water applied was estimated (m^3/ fed.)("Water measurement manual : a guide to effective water measurement practices for better water management").

XI. Water consumptive use (WCU) = Water applied as m^3/ fed.: The quantities of consumptive use were calculated for the 60 cm soil depth which was a to be the depth of the root zone as reported by many investigators as described by (Israelsen 1962).

$$CU=\frac{ø1-ø2}{100}\times B.d\times\frac{Depth}{100}\times Area\ (4200\ m^2)$$

Where:

CU= Amount of water consumptive use.

Ø2= Soil moisture content % by weigh after irrigation.

Ø1= Soil moisture content % by weigh before the next irrigation.

B.d= Bulk density (g/cm^3)

XII. Water saving per area.

XIII. Crop water use efficiency (C.W.U.E). The crop water use efficiency is the weight of marketable crop produced per unit volume of wat consumed by plants or the evapotranspiration quantity. It was computed for the different treatment by dividing the yield (kg/fed) on units of evapotranspiration expressed as cubic meters of water per fed. It was calculated by the following formula.

$$\mathbf{CWUE}=\frac{\textbf{yield (kg/fed)}}{\textbf{water consumptive use (m}^3\textbf{/fed)}}$$

The hydrogel was placed in the soil before planting. Other commonly suggested techniques for commercial processing potato production were carried out in accordance with Egyptian Ministry of Agriculture recommendations.

After 80 days after seeding, five plants were randomly selected and tagged from each experimental unit to test vegetative growth characters such as

plant height, plant fresh weight of vine gm/plant, plant dry weight of vine gm/plant which was calculated from drying the whole plant vegetative portion plant stem and leaves at 65-70℃ till constant weight. The potassium components of leaves after 80 days from planting were also determined.

RESULTS

Vegetative growth parameters:

Plant height:

Data presented in Table 3 shows that plant height of potato plant cv. Lady Balfour was significantly affected by irrigation regime. The regime (irrigation regime every 10 days) showed the highest values of plant height (86.27 and 79.54 cm) compared to the second regime every 20 days showed an average of plant height (76.48 and 77.60cm) in the first season. In the second season, data shows that the differences between the two regimes were not significant.

Regarding the effect of hydrogel treatments, the highest concentration showed the best significantly effect in improving plant height. The highest concentration showed plants with an average of (87.62 and 80.80 cm) compared to control treatment which showed plants with an average of (74.33 and 79.33 cm) in the first and second season respectively.

The interaction effects between (IR) and (HG) treatments were highly significant. The best treatment was irrigation every 10 days with the highest concentration of (HG) which showed plant height values of (91.66cm and 84.13cm) in the first and second season respectively and the lowest one was the second irrigation regime with control plant which showed (68.33).

Plant fresh weight of vine as (gm/plant):

Data shows that (IR) treatments had a significant effect on this trait in both seasons. The first irrigation treatment (irrigation every 10 days) showed the highest values of fresh weight g/plant in both seasons compared to the second irrigation regime (every 20 days) which showed lower values in both seasons.

Regarding the effects of hydrogel treatments on plant fresh weight, data in the same table showed that there was a significant increase in plant fresh weight in comparison with control group. The highest values of these treats in both seasons were obtained with the highest concentrations of hydrogel in both seasons (741.73 and 767.85) respectively.

The interaction between (IR) and (HG) treatment is showed significant effect in the

two seasons. The treatment of irrigation every 10 days and soil additive with HG at 5.0 kg / fed showed the highly significant increase plant fresh weight (747.4and795.89/plant) in the first and second season respectively.

Plant dry weight as (gm/plant):

Dry weight(g-plant) of potato plant was not affected with irrigation regime. The first regime was better in its effect but without significant difference in compared to the second regime.

Application of hydrogel treatment to the soil significantly improves the dry weight of potato plants in both seasons when compared with plants in control group it was noted that the best effect

was relevant to the highest hydrogel concentration.

Data in Table 3 indicates that irrigation regime and hydrogel treatment had a significant effect on dry weight gm/plant in both seasons.

Tuber dry matter percentage:

Data in Table 4 shows that the first regime irrigation (each 10 days) had a higher percentage of tuber dry matter percentage (16.72% and 16.77%)compared to the second regime treatment (irrigation each 20 days) (15.93 and 16.93). This result was observed in the first season.

Also (Table 4) showed that the soil additive with hydrogen especially with the highest concentration led to improve and the increase tuber dry matter percentage significantly in comparison with control plants in both season (16.66 and 16.93%) compared to control treatment (15.78 and 16.83%)

The interaction effects between IR and HG treatments were significant in the both seasons. The highest increase was found with the treatment of IR every 10 days with soil additives at 5.0 kg /fed (17.34% and 17.50 %) in the first and second season respectively .

Specific gravity:

Data in (Table 4) shows that the second irrigation regime (20 days) had higher values for specific gravity/tuber compared to the first irrigation regime with significant difference with another regime.

It was noted that the specific gravity was significantly increased positively with the highest concentration of hydrogel.

Interaction treatment showed significant differences in both seasons.

Potassium %:

Results showed that potatoes grown in plots of soil treated with hydrogel showed higher concentration of potassium when compared to those grown in untreated plots in both seasons.

Significant differences between average values of K concentration in leaves of potato plants cv "Lady Balfour" after 80 days from sowing were observed according to data in Table 4. The percentage of K in potato plant leaves increased with shorter irrigation intervals (10 days) (2.9% and 2.75%) compared to 20 days intervals (2.6 and 2.47 %) .

Hydrogel soil additive treatment is before blending showed significant effect. At high concentration of HG K% in the leaves of potato plant cv. lady Balfour recorded the highest values in both season (3.06 % and 2.94 %) when compared with the control plant treatment is (HG = 0.0)

Number and weight of large tubers/plant:

Data presented in Table 5 shows that irrigation regime (every 10 days and every 20 days) had a significant effect on both number and weight of large tubers/plant in both seasons.

The IR every 20 days led to the highest number of tubers/ plants, while the IR every 10 days showed the highest values of large tubers weight (g/plant) with a significant difference in both seasons.

Also , data in the same table showed that soil additive HG rates showed significant effect on both number and weight of large tuber in compared with control treatments. expect in the first season what is the difference between values of number of tuber /plants were not significant. The highest significant values were was recorded with HG rates

5.0 k.g (3.96 and 3.94) for number of large tubers / plant and 423.96 and 367.9 gm /plant for weight of tuber /plant.

The interaction effect between irrigation regimes and hydrogel treatment were significant in both season for both number and weight of large tuber /plant the highest value for number of tuber /plant was achieved with ER every 20 days and the soil additives by HG at 5.0 kg. /fed and ER every 10 days recorded the highest significant values for weight of large tubers /plant (431.14 and 426.78 g/plant) in the first and second season respectively.

Number and weight of medium tuber/plant:

The highest values of number and weight of medium potato tubers were obtained from potato plants irrigated every (10 days) in both seasons compared to longer irrigation intervals (each 20 days) both number and weight of medium tuber/ plant will increase after application of hydrogel treatment to the soil significantly in both seasons.

Also, both the number of and weight of medium tuber / plant were increased with the application treatment of hydrogel to the soil in both seasons.

The highest rate of hydrogel showed (4.09, 4.39) and (194.9 and 182.64 g/plant) in both seasons.

Number and weight of small tuber/plant:

Data presented in table (5) show that the number and weight of small tubers/plant was affected significantly with irrigation intervals treatments.

The longest irrigation intervals (each 20 days) showed the highest values(4.81and 5.63) for number of small tuber and(221.3and 253.63) for weight of small tuber in first and second seasons respectively in compare with the shortage irrigation intervals (10 days) which showed (4.65 And 5.28) for the number of small tuber and (219.6 and 243.77) for the weight of small tuber , all differences between two irrigation regimes for number of small tubers per plant was significant in the both seasons except for the weight of small tuber in the first season which was unsignificant.

Regarding the effect of hydrogel treatments, data in the same table show that those plants which are treated with hydrogel showed decreasing in their productivity of small tubers per plant as number or weight in both season in compare with those plants which untreated with hydrogel treatment.

The interactions between experiment treatments data showed that there is a significant effect for these interactions. Where's the lowest (3.79) and (4.65) in the first and second seasons respectively values number of small tubers was obtained with those plants which treated with the first regime of irrigation each 10 days and treated with hydrogel rates.

While the highest number of small tubers (5.81), (6.22) was observed with those plants which irrigated every 20 days and not treated with hydrogel (control plants).

These results show that with water shortage there are adverse effect on potato tuber size and led to increase the number of small tuber / plants. Also, data showed that with added hydrogel particularly with High Street this adverse effective for water shortage was disappeared and tuber size was improved and increased.

Total yield ton/fed:

Data in Table 5 shows that total yield (ton/fed) significantly decreased in second season as irrigation intervals time increased from 10 to 20 days from (12.43 to 11.43 ton/fed) with insignificant difference in the first season (12.43 ton /fed).

Soil additives pre-planting with hydrogel led to significantly increasing in total yield ton / fed compared to HG = 0.0 in both seasons

Concerning to interactions effects data revealed that ER every 10 days with H. G= 5.0 kg / fed had the highest values 13.94 and 14.13 ton / fed compared to the control treatments 11.02 and 11.07 ton / fed in the first and second season respectively.

Water measurements:

Water applied as m^3/fed: Data in Table 6 shows that when plants were irrigated every 20 days, the quantity of water applied was lower compared to when irrigated every 10 days.

Water saving m^3/area:

Water saving cubic meter/area as shown in Table 6 indicates that total saving water irrigation was lower with plants irrigated every 20 days compared to those irrigated every 10 days.

Water use efficiency(kg/m^3):

Data presented in Table 6 shows that the best treatment which had the highest value for water use efficiency was observed with plants irrigated every 10 days and treated with hydrogel at its highest concentration.

The study investigated the effect of irrigation regimes every (10 days and every 20 days) and the use of hydrogel as soil additive pre-planting with three rates (0, 2.5, and 5.0 kg per fed.) as a soil additive on plant growth, water use efficiency, productivity, and tuber quality of potato c.v. Lady Balfour.

Data showed that with the first irrigation regime (every 10 days) most growth characters were improved in compare with the second regime(every 20 says) except percentage of plant dry weight. This decreasing in plant growth parameter with the second regime may related to decreasing in water quantity which of course caused reducing in vital process in plant such as photosynthesis, respiration, and transpiration and this related to decrease plant cell division and elongation resulted in decreasing in plant growth.

According to decreases plant growth parameters both yield, and its component were affected adversely with shortage water quantity these results are in agreement with Nasir and toth (2022) who showed that the new potato cultivars are susceptible to loss of yield because drought stress.

After applied hydrogel treatments data showed that the adverse effects of water shortage disappeared grandly with increasing the hydrogel rate these results are in barrel with that's reported by many researchers showed that hydrogel return soil moisture well and mineral nutrition in its reduce environmental pollution(Hou et al .,2018) .

The good effect for hydrogel may be related to its role in improving tolerant of water stress characters in plant and its role for improving plant growth and productivity these results are in harmony with that reported by (Abdel-Aziz et al.,2022) who showed that using hydrogen in agriculture provided solutions to several problems.

The results showed that irrigation regime had a significant effect on plant height, with the first regime (irrigation every 10 days) showing the highest values of plant height compared to the second regime. Hydrogel treatment also had a significant effect on plant growth number, weight of large and medium tubers and also total yield(fed). These results may be due to increase of the nutrient concentration by the addition of hydrogel to the soil. These results are the same reported by (Ibrahim et al., 2015) with the highest concentration showing the best effect in improving plant height.

Irrigation intervals treatment also had a significant effect on plant fresh weight of vine gm/plant in both seasons. The first irrigation treatment (irrigation every 10 days) showed the highest values of fresh weight g/plant in both seasons compared to the second irrigation regime (every 20 days) which showed lower values in both seasons. Many researchers showed that potatoes have little tolerance to water stress and the potato crop needs the optimum water to obtain optimum growth and yield (Vundavelli et al., 2014, Febad et al.,2017 and Shock et al., 2021).

Hydrogel treatment also had a significant effect on dry weight gm/plant in both seasons. The percentage of K in potato plant leaves increased with shorter irrigation intervals (10 days) compared to 20 days intervals. Total yield (ton/fed) significantly decreased only in the second season as irrigation intervals time increased from 10 to 20 days. While in the first season data revealed insignificant effect. Therefore, application of irrigation every 10 days is recommended.

CONCLUSION

In conclusion, pre-treatment of the soil with hydrogel at rate of 5.0 kilogram/ fed and the irrigation regime every 10 days starting from the completion of germination (4 week from sowing) is important to improve blend growth, yield, quality and use efficiency of potato cultivar “lady Balfour” as well decrease the adverse effect of brought stress**.**

Table 1: The physical and chemical properties of the soil used for growing potato before planting in both seasons of (2019/2020-2020/2021).

Soil properties	Sand %	Silt %	clay	Texture grade	CaCo3 % PH	Organic Matter%	PH	EC M. mhos/cm	N%	Available P (ppm)	Available K (ppm)
1st season	25.66	32.61	41.73	Clay loam	2.91	1.64	7.31	1.61	0.28	24	261.0
2nd season	23.58	34.81	41.61	Clay loam	2.69	1.46	7.28	1.58	0.24	26	234

Table 2: Some economical characters potato cv. Lady Balfour ,British potato variety handbook (2011).

Cultivar	Lady Balfour	
Parentage	8204 A4 ×15119 AC5	
Tuber characteristics	Smoothness of skin	Medium
	Shape of tuber	Oval
	Depth of eyes	Medium
	Color of skin	Red parti-colored
	Color of flesh	White
Botanical description	Height of plant	Very tall
	Frequency of berries	Absent
	Color of base of light sprout	Pink
Characters	Lady Balfour is a very high yielding under Egyptian conditions in new reclaimed and old lands (Delta and middle Egypt) in both cultivation seasons (summer and winter). Productivity is around 12-15 ton / fed for old land, ranged from 12-14 for reclaimed lands.	
Maturity	Main crop	115 days

Table 3: The effect of irrigation regime and Hydrogel as soil application on plant height (cm), fresh weight/ plant and dry weight in the first and second season of 2018/2019 and 2019/2020

Irrigation regime / **Hydrogel rates**		**Plant height**		**Plant fresh weight (g /plant)**		**Plant dry weight (g /plant)**	
		First season	Second season	First season	Second season	First season	Second season
A1	B1	80.33	74.33	651.23	595.09	74.7	72.4
	B2	86.83	80.16	581.33	679.77	83.7	79.9
	B3	91.66	84.13	747.4	795.8	84.3	83.3
Mean of A		**86.27**	**79.54**	**659.98**	**690.22**	**80.9**	**78.53**
A2	B1	68.33	74.33	505.06	501.56	72.6	72.2
	B2	77.55	81.03	634.05	711.09	76.4	74.5
	B3	83.57	77.46	736.06	739.9	80.4	81.5
Mean of A		**76.48**	**77.60**	**625.05**	**650.85**	**76.46**	**76.06**
Mean of B		74.33 82.19 87.62	79.33 80.59 80.80	578.15 607.70 741.73	548.33 695.43 767.85	73.65 80.05 82.35	72.3 77.02 82.40
L.S. D		A=3.13 B=3.03 AB=4.01	A=3.01 B=3.41 AB=4.02	A=12.08 B=12.61 AB=13.03	A=11.02 B=12.01 AB=13.04	A=7.77 B=8.16 AB=11.02	A=8.08 B=8.21 AB=10.88

A1= Irrigation every 10 days. B1= control treatments.
A2= Irrigation every 20 days. B2= hydrogel at 2.5 kg/ fed
B3= hydrogel at 5.0 kg/ fed

Table 4: The effect of irrigation regime (IR) and hydrogel rates (HG) on Tuber dry matter % & Specific gravity& K % in leaves during (2018/2019 and 2019 /2020)

Irrigation regime hydrogel concentration		Tuber dry matter %		Specific gravity		Potassium %	
		First season	Second season	First season	Second season	First season	Second season
A1	B1	15.94	15.97	1.23	1.16	2.23	2.22
	B2	16.88	16.85	1.39	1.33	3.16	2.72
	B3	17.34	17.50	1.40	1.46	3.50	3.32
Mean of A		**16.72**	**16.77**	**1.34**	**1.31**	**2.9**	**2.75**
A2	B1	15.62	17.68	1.35	1.29	2.71	2.26
	B2	16.19	15.43	1.73	1.37	2.52	2.59
	B3	15.98	16.36	1.35	1.57	2.62	2.57
Mean of A		**15.93**	**16.49**	**1.47**	**1.41**	**2.61**	**2.47**
Mean of B		15.78 16.54 16.66	16.83 16.14 16.93	1.29 1.56 1.38	1.23 1.35 1.52	2.47 2.84 3.06	2.24 2.66 2.94
L.S. D		A=0.30 B=0.33 AB=0.50	A=0.33 B=0.29 AB=0.47	A=0.01 B=0.02 AB=0.03	A=0.01 B=0.01 AB=0.02	A=0.23 B=0.21 AB=0.27	A=0.19 B=0.22 AB=0.25

A1= Irrigation every 10 days. B1= control treatments.
A2= Irrigation every 20 days. B2= hydrogel at 2.5 kg/ fed
B3= hydrogel at 5.0 kg/ fed

Table 5: The effect of irrigation regime and spraying plant with hydrogel on Number and weight of large and medium tuber and total yield (ton/fed) during 2018 -2019 , 2019-2020 seasons.

Irrigation regime hydrogel concentration		Number of large tubers		Weight of large tuber		Number of medium tubers		Weight of medium tuber		Number of small tubers		Weight of small tuber		Total yield	
		First season	Second season	First season	Second season	First season	Second season	First season	Second season	First season	Second season	First season	Second season	First season	Second season
A1	B1	3.12	3.23	313.55	304.97	3.51	2.43	160.43	158.43	5.75	6.06	264.6	280.6	11.02	11.07
	B2	3.76	3.79	369.36	365.80	4.08	4.02	166.4	169.03	4.31	5.04	202.6	236.9	12.34	12.21
	B3	3.58	3.48	431.14	426.78	4.69	4.39	194.9	182.64	3.91	4.75	191.6	213.8	13.94	14.13
Mean of A		**3.48**	**3.5**	**371.35**	**365.85**	**4.09**	**3.61**	**173.91**	**170.03**	**4.65**	**5.28**	**219.6**	**243.76**	**12.43**	**12.47**
A2	B1	4.39	3.23	304.97	293.06	3.54	3.28	132.5	198.56	**5.81**	5.99	238.2	273.5	11.86	10.19
	B2	4.01	4.22	333.8	354.63	3.70	4.44	145.16	164.96	4.39	5.77	216.3	260.7	12.21	10.84
	B3	4.33	4.39	416.78	309.13	4.15	3.46	166.06	173.56	4.23	5.14	209.4	226.7	13.24	13.27
Mean of A		**4.24**	**3.94**	**351.85**	**318.94**	**3.79**	**3.72**	**147.90**	**179.02**	**4.81**	**5.63**	**221.3**	**253.63**	**12.43**	**11.43**
Mean of B		3.76 3.86 3.96	3.23 4.01 3.94	309.26 315.58 423.96	299.15 360.22 367.96	3.53 3.89 4.42	2.55 4.23 3.93	146.47 155.78 180.48`	178.49 166.97 178.1	5.78 4.27 4.07	6.025 5.405 4.945	251.4 209.45 200.5	277.05 248.8 220.25	11.44 12.32 13.59	10.63 11.53 13.7
L.S. D		A= 0.46 B=0.51 AB=0.68	A=0.43 B=0.47 AB=0.35	A=11.02 B=11.98 AB=14.55	A=12.02 B=11.88 AB=15.54	A=0.14 B=016 AB=0.25	A=0.16 B=0.21 AB=0.27	A=8.18 B=11.02 AB=13.05	A=7.07 B=8.18 AB=12.05	A= 0.14 B= 0.24 AB=0.29	A=0.24 B=0.30 AB=0.34	A=N.S B=10.21 AB=11.08	A=8.08 B=9.02 AB=10.05	A=0.39 B=0.41 AB=0.52	0.33 0.34 0.46

Table 6: The effect of irrigation regime and hydrogel rate as soil application on some soil water measurements on potato plant.

Irrigation regime hydrogel concentration		Water applied m^3/fed		Water saving		Water use efficiency	
		First season	Second season	First season	Second season	First season	Second season
A1	B1	3120	3270	0	0	3.53	3.39
	B2	2985	3150	135	120	4.18	3.88
	B3	2786	3050	343	220	2.48	4.63
Mean of A		2963.6	3156.6	239	170	3.39	3.96
A2	B1	1730	1750	0	0	6.86	5.82
	B2	1570	1625	160	125	7.78	6.67
	B3	1490	1630	240	120	8.89	8.14
Mean of A		1596.6	1668.3	200	122.5	7.84	6.87
Mean of B		2425 2277.5 2138	2510 2387.5 2340	00 215 463	00 122.5 170	5.195 5.98 5.69	4.61 5.38 6.39

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الملخص العربي

" تحسين إنتاجية البطاطس بمعاملات الهيدروجيل وإدارة الري "

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بحثت هذه الدراسة في تأثير أنظمة الري بفترتين (10 أيام و 20 يوما) واستخدام هيدروجيل بثلاثة تركيزات (0 و 2.5و 5 كجم لكل فئة) كمادة مضافة للتربة على نمو النبات وكفاءة استخدام المياه والإنتاجية وجودة الدرنات لنبات البطاطس السيرة الذاتية ليدي بلفور. أجريت التجربة في المزرعة التجريبية لقسم البستنة بكلية الزراعة بجامعة المنيا على مدار موسمين متتاليين من نيلي (2019/2018 و 2020/2019). تم إجراء تحليل التربة باستخدام طرق مختلفة وتم إعداد التجربة في قطع الأراضي المقسمة باستخدام تصميم كتلة عشوائية كاملة مع أربعة مكررات. أظهرت النتائج أن نظام الري كان له تأثير معنوي على معايير نمو النبات أي ارتفاع النبات ووزن النبات الطازج والجاف حيث أظهر النظام الأول (الري كل 10 أيام) أعلى قيم لنمو النبات مقارنة بالنظام الثاني. كان لعلاج هيدروجيل أيضا تأثير كبير على نمو النبات. أعلى تركيز يظهر أفضل تأثير في تحسين ارتفاع النبات. كما كان لمعالجة فترات الري تأثير كبير على النمو والمحصول ومكوناته في كلا الموسمين. العلاج هيدروجيل وكان لها تأثير كبير على الوزن الجاف جم / النبات في كلا الموسمين. في الختام ، وجدت الدراسة أن نظام الري ومعالجة الهيدروجيل كان لهما تأثيرات كبيرة على معايير النمو المختلفة لنباتات البطاطس. أظهر نظام الري الأول (الري كل 10 أيام) ومعالجة الهيدروجيل بأعلى تركيز له أفضل النتائج في تحسين نمو النبات وكفاءة استخدام المياه والإنتاجية وجودة الدرنات