Effect soil conditioner on some soil characteristics and sugar beet plant growth, nutrients content and yield characters under different water regimes.

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ABSTRACT

Water stress is considered as one of the major factors responsible for reducing sugar beet crop productivity. A field experiment was carried out at El-Emam Malek, El-Bostan district, El Behira governorate, Egypt, at 2022-2023, to study the effects of sprayed soil conditioner (glue: 0, 2, 4; 6 %/spraying solution) on some hydrophysical soil characteristics and yield, yield parameters, water use efficiency of sugar beet and some soil properties under different water regimes, WR (100, 85 and 70% from ETo). Results showed the reduction in the irrigation quantities led to increase in sugar beet leaf content from N, P, K and Ca content. So, the highest values were recorded at WR 70%+6% glue in spraying solution (N, 3.50 %), P (1.70%) and 100 WR (K, 3.25% and Ca (1.84%) and water regime treatment 85% scored the highest values for chlorophyll A, B and carotenoids, while the lowest ones were recorded at 70 % WR. The highest yield of sugar beet was observed under a 100 % water regime that increased with an increase in glue concentration by 85 % water regime. Water regime at 100 % and 6 % glue in spraying solution scored the highest yield (36.65 ton/fed) followed by 85 % WR at the same sprayed glue (33.84 ton/fed) with a reduction 7.7 %. Increasing sprayed glue concentration enhanced the content of chlorophyll A, B and carotenoids after 6 % glue/liter and the lowest ones were obtained at control. Decreasing applied water is associated with a reduction in HC, which is calculated in percentage with values 5.6 and 8.6 % after 85 and 70 %WR compared with 100 %WR, respectively. Glue concentration has a significant negative correlation with HC value and the reduction in HC was estimated in percentage with values 5.8, 12.9 and 18.9 % after 2, 4; 6 % glue in spraying solution. Increase concentration of glue-enhanced aggregates > 2mm with percentage values 2, 4 and 6 % glue, respectively and attributed the enhancement of the aggregates more than 2 mm to decrease soil evaporation and to dry-wet cycles that enhanced aggregates from side and soil ability to retain more water. Total applied irrigation water during the growing season was 2480.40, 2108.24 and 1736.28 m^3/fed for 100, 85 and 70 % water regimes, respectively. The highest water use efficiency value was recorded at WR 85 %+6 % glue in water solution (16.05 kg/m^3) followed by 70 % water regime +6 % glue (15.46 kg/m^3).

Key words: Sandy soil, sugar beet, drip irrigation, water regime, nutrients, plant growth, yield; yield characters.

INTRODUCTION

Egypt is one of the most vulnerable countries to the potential impacts and risks of drought stress that reduced crops productivity that affecting on the food security. Water stress in Egypt is expected regarding to progressive increase population and their demand from food, fiber and increasing water consumption. Drought is one of the most important growth restricting environmental factors for crop species in arid and semi-arid regions as well as crop losses resulting from abiotic stresses (Chaves and Oliveira 2004). With respect to the climate change effects, which can inhibit the growth and development of plants, mainly by decreasing photosynthesis, leaf turgor, and transpiration rates (Tahi et al., 2007). Reduction in the production capacity of soils is attributed to its physical constraints, which envisages that the maintenance of soil's physical properties allows substantial crop growth for better crop production (Shinde et al., 2019). Sugar beet (Beta vulgaris L.) is considered the most important sugar crop in Egypt and comes after sugar can as a source of sugar and plays a prominent role in sugar production (57.7% of the local sugar production), which amounted to 1.25 million tons (Sugar Crops Council Report, 2020). It is an important crop that helps in establishing integrated agricultural-industrial societies, especially in the newly reclaimed areas, and contributes for many industries such as the sugar industry, and highly-value animal feed (Moliszewska et al., 2016).

So, the challenge facing the growers of sugar beet is to optimize irrigation water requirement with suitable irrigation methods and the water regime needed. Nowadays, limited irrigation water becomes a fact, agriculture practices are organized for optimal water use and maximum yield per water unit. Under water scarcity conditions, water management will have to be more efficient. The process of crop water use has two main components, evaporation losses from the soil and the crop evapotranspiration (Fereres and Soriano, 2007). There is a potential for improving water productivity under scarce supplies, so deficit irrigation (application of water below full crop water requirements) is one of the tool to achieve the goal of reducing irrigation water use.

Soils contain a certain supply of mineral and organic nutrient sources, which often need to be supplemented with organic and inorganic soil conditioners and applied fertilizers for improving plant growth (EI-Dolify et al., 2016). Recently, the use of fertilizers and chemical inputs with less focus on soil conditioners and soil amendments be considered. Improvement of the soil physical conditions such as porosity permeability and soil ability to retain more water for the agricultural applications is a must (Mukherjee, 2013). Whereas, soil conditioners are materials that contain essential nutrients to improve the physical, chemical and/or biological properties of the soil, and remarkably plant growth. Also, it can benefit food production through the control of soil degradation, improvement of soil-air-water relations, amendment of soil drainage and soil aggregation to overcoming water repellence (Shinde et al., 2019; Abdelhady et al., 2016; Ebtisam and Abdelhady 2015)

In general, soil conditioners can be classified into three groups: organic, industrial waste-based, and synthetic soil conditioners such as glue, which is a disposed material from laser manufactured and consider as poly saccharides from side and as a polymer from other one (EI-Dolify et al., 2016). They reported that diverse natural and synthetic wastes may be recycled and reused as plant nutrients source and can absorb nutrient too. Intensive agriculture is producing an enormous number of agricultural by-products, which could be considered as a great option in soil conditioning for sustainable agricultural productions. Not only plant origin wastes but also Industrial by-products have been transformed into soil conditioners in agriculture, which can also be useful for sustainable agricultural productions (Bray et al., 2018). Apart from improving the soil physical properties, polymeric organic materials can act as buffers against short-term drought stress and improve the crop establishment (Abdallah et al., 2021). Therefore, this experiment was carried out to study the effect of the sprayed glue, as soil conditioners, on the yield, yield parameters and water use efficiency of sugar beet and some soil properties under different water regime.

MATERIALS AND METHODS

Field experiments was carried out in 2022/2023 season at El-Emam Malek, El-Bostan district, El- at Nubaria district (National Research Centre Experimental and Production Station), El-Behiera Governorate, Egypt to study the effect of the sprayed glue (0, 2, 4; 6 % glue in spraying solution), as soil conditioners, on the yield, yield parameters and water use efficiency of sugar beet and some soil properties under different water regime (100, 85; 70 % from ETo) in sandy soil (30°.52 N, 30°.32E longitude and the altitude is 28 m above the sea level).

Soil samples were collected from experimental area to determine the main soil physical and chemical properties (0-15 cm). The soil physical parameters (soil texture class) were determined after (Gee and Bauder, 1986), soil-moisture constants (soil field capacity, wilting point and available water) after (Klute, 1986). The soil chemical properties, EC, pH, organic matter and total calcium carbonate were determined according to (Soil Survey Staff. 1999). The soil main physical and chemical properties are listed in Tables 1.

Table (1) Some physical and chemical properties of the experimental soil.

	Particle size distribution %				*Soil water constant %wb*			
Properties	*Sand*	*Silt*	*Clay*	*Texture*	*Saturation*	*FC*	*WP*	*AW*
Value	*78.2*	*14.6*	*8.2*	*Sandy loam*	*28.3*	*17.8*	*5.6*	*12.2*
	Chemical properties					*Macronutrient %*		
Properties	*EC dS/m*	*pH*	*Organic matter %*		*$CaCO_3$ %*	*N*	*P*	*K*
Value	*2.08*	*8.03*	*1.15*		*5.8*	*1.75*	*0.83*	*1.14*

FC: field capacity, WP: wilting point, AW: available water, wb: weight basis

Dry aggregate size distribution was determined by the standard dry-sieving method (Hillel, 2004) was carried out for collected soil samples after > 2mm and < 2mm .
Hydraulic conductivity (HC) was measured in the laboratory under a constant head technique (Klute and Dirksen, 1986) using the following formula: $HC = \frac{QL}{At\,\Delta H}$ *, where*
HC: hydraulic conductivity (cm³/h), Q: volume of water (cm³), A: cross sectional flow area (cm²) L: length of the soil sample (cm) and ΔH: differences in hydraulic head across the sample (cm) and t: time (h).
The chemical analysis of irrigation water is 645 ppm (EC), 7.26 (pH) and 2.14 (sodium adsorption ratio).
Drip irrigation was installed with lateral length 30 m and 0.3 m among dripper (GR with discharge 4 liter/h) and 0.75 m between laterals. Also, uniformity coefficient of installed drip irrigation system was estimated (87.25%).
Experimental was treated by compost (10 m³/fed), calcium superphosphate (200 kg/fed) and granule potassium sulphate (50 kg/fed) well mixed during soil ploughing and soil preparation. Seeds of sugar beet (Beta vulgaris L. cv Gazelle) was planted at 12 October 2022 and harvest at 7 May 2023 on ridges 60 cm apart and 20 cm between hills. The sugar beet plants lasted 200 days. Glue at different concentration was mixed with lime at 1%/L (to recognize the treatments), after planting sugar beet, according to (Ghazzawy et al., 2022; Hellal et al., 2019; Abd-Elmabod et al. 2029a,b; Mansour and Abdullah 2012, Mansour and El-Melhem 2015; Mansour 2015a,b; Mansour et al., 2015 a-d; Mansour et al., 2019 a-f).
Ammonium sulphate (50 kg), ammonium nitrate (100 kg), phosphoric acid (25 liter) and potassium

sulphate (150 kg) were applied during growing season. Glue solution at different concentration was sprayed on soil surface at germination completed (15 days after planting) by 5 liter/m^2. After 50 days from planting, sugar beet plants were sprayed by micronutrients and amino acids twice and 2 weeks among. All agriculture processes were caried out according to (Egyptian Agriculture Ministry and soil Reclamation) included resistance of weeds, insects and fungi. The amounts of irrigation water were calculated 2480.40, 2108.24 and 1736.28 m^3/fed for 100, 85 and 70 % water regime treatments, respectively.

At harvesting, a sample of ten plants was taken at random from each sub-sub plot and topped to determine the root length (cm), root width (cm), root weight (kg), leaf area (cm^2), and root volume (cm^3). The contents of photosynthetic pigments were determined according to the method described in (AOAC, 2012). Determination of sucrose: Sucrose percentage was estimated in fresh samples of sugar beet root using "Saccharometer" according to the method described by AOAC (2012).

Statistical analysis was carried out after Snedecor and Cochran (1990), in factorial analysis where the water regime treatments occupied the main plots while the sub plots were assigned for soil sprayed glue concentration and each treatment was triplicated. Treatment mean comparisons were done using least significant difference (LSD) at 5% level of probability. After homogeneity test, combined analysis was done to compare between the two irrigation systems.

RESULTS AND DISCUSSION

Data in table 2 showed the effect of the sprayed glue with different concentration on some sugar beet plant characters (leaf area, root length, root width, root volume and root) under different water regime (100, 85; 70 %ETo). The untreated plot gained the lowest values of leaf area, root length, root width, root volume and root weight while 6 g/liter scored the highest values. One can notice that the highest values of the previous studied sugar beet parameter were attained after 100 %WR followed by 85 % WR after sprayed 6 % glue in spraying solution, while the opposite was true in case of 0 g/liter glue.

Regarding to the irrigation water regime, data in table 2 indicated that decreased applied irrigation water (WR treatments) led to reduction in of the studied sugar beet parameters that represented in percentage as follow17.2, 0.2, 0.0, 10.1; 9.9 %after 85 %WR and after 70 %WR were 33.8, 6.9, 16.1; 29.4% for leaf area, root length, root width, root volume and root weight, respectively. With respect to the sprayed glue (on soil surface) effect on the leaf area, root length, root width, root volume and root weight, data pointed out that sprayed glue has a superior effect on the previous parameters which enhanced by 12.9, 0.3, 11.5, 8.3; 31.2, 8.7, 17.0, 14.0 and 64.0, 11.7, 21.6, 19.3, 24.4 % after sprayed soil surface by glue at 2, 4; 6 % glue in spraying solution compared with control (untreated plot, in same sequences.

The inter action effect of the studied two factors on the sugar beet root yield and water use efficiency (WUE), total sugar and sugar yield /fed under different water regime were recorded in table 2. Water regime at 100 % and sprayed 6 % glue in spraying solution scored the highest yield (36.65 ton/fed) followed by 85 % WR at the same sprayed glue (33.84 ton/fed) with reduction 7.7 %. Meanwhile, untreated plot recorded the lowest yield (21.30 ton/fed) under 70 %WR. According to the effect of the water regime on the sugar beet yield, data pointed out that decrease applied irrigation water from 100 % ETo to 85 and 75 % led to reduction by about 10.3, 28.3 %, whereas as increased concentration of glue resulted increase was attained by 5.5, 15.7 and 22.1% after 2, 4, 6 % glue in spraying solution above untreated plot. Same trend was noticed in total sugar and sugar yield /fed with increase percentage 6.6, 10.7, 15.4 and 15.7, 34.7 and 50.5 % in same previous consequence.

Table (2) Effect of glue concentration on the hydraulic conductivity and aggregate percentage under different water regime on sugar beet crop.

Water regime %	Glue % glue in spraying solution	Leaf area	Root length	Root width	Root volume	Root weight	Root yield	WUE	Total Sugar	sugar yield
		cm^2	cm	cm	cm^3	Kg	ton/fed	kg/m^3	%	ton/fed
100	0	15.40	35.30	28.65	563.25	2.05	31.25	12.60	10.77	3.37
	2	17.95	29.87	32.85	652.16	2.21	32.46	13.09	12.13	3.94
	4	23.45	33.23	33.32	678.25	2.31	34.82	14.04	12.60	4.39
	Mean	**22.24**	**33.29**	**32.73**	**657.04**	**2.24**	**33.80**	**13.63**	**12.22**	**4.15**
85	0	14.88	29.40	29.14	557.20	1.85	27.15	12.88	10.85	2.95
	2	17.25	31.23	31.58	556.85	1.97	28.95	13.73	11.64	3.37
	4	19.22	35.57	34.82	615.41	2.09	31.25	14.82	12.74	3.98
	Mean	**18.42**	**33.21**	**32.75**	**590.67**	**2.02**	**30.30**	**14.37**	**12.17**	**3.71**
70	0	13.25	28.02	24.80	442.31	1.24	21.30	12.27	10.88	2.32
	2	13.95	31.88	27.63	483.21	1.55	22.70	13.07	11.84	2.69
	4	14.42	32.01	28.50	489.34	1.68	26.13	15.05	12.45	3.25
	6	17.25	32.11	28.91	496.27	1.85	26.85	15.46	13.16	3.53
	Mean	**14.72**	**31.01**	**27.46**	**477.78**	**1.58**	**24.25**	**13.96**	**12.08**	**2.95**
LSD5%	Water regime	2.34	0.18	3.41	63.24	1.12	3.14	1.58	1.55	1.65
	Glue	2.11	0.15	2.45	42.11	0.94	2.56	1.47	1.37	1.41
	Interaction	1.97	ns	2.31	21.85	0.78	2.11	1.23	1.16	1.25

Same trend was attained in case of the sugar yield /fed. With respect to the water use efficiency (WUE), total applied irrigation water during growing season were 2480.40, 2108.24 and 1736.28 m3/fed for 100, 85 and 70 % water regime, respectively. Results revealed that WR 70 + 0 % glue recorded the lowest value (12.27 kg/m^3), while the highest value was recorded at WR 85 %+6 g/liter glue (16.05 kg/m^3) followed by WR 70 %+6 g glue (15.46 kg/m^3). Also, data pointed out that it is easy to arrange WUE value in descending order as follows: 14.63>13.96> 13.63 kg/m^3 for 85, 70; 100 % water regime, respectively. Whereas, increase of glue concentration associated with increase in total sugar with percentage 9.6, 16.3; 23.0 % for 2, 4; 6 % glue in spraying solution compared with control.

Amr et al., (2017) found that drip irrigation system with 1322 m^3/fed water, that represent about 60% from optimum requirements give the best satisfy yield and good quality of sugar beet crop under sandy soil. Although, low irrigation, in which plant is sustain water stress in whole season, is one of methods to maximize WUE and to increase yield in face of a unit of used water. Also, there is harmony with those obtained by Hosseinpour et al. (2006), who reported that the enhancement in beet leaf strongly influenced by soil ability to supply plant by enough water. Although Al-Barbari et al., (2014) mentioned that deficit irrigation usually increases sucrose content in ro

Table (3) Effect of glue concentration on the macro and micronutrients of sugar beet leaf content under different water regime.

Water regime	Glue %/L	N	P	K	Ca	Chlorophyll		Carotenoids
%		%				A	B	%
100	0	3.15	1.45	2.89	1.61	5.34	3.31	1.15
	2	3.27	1.51	3.01	1.69	5.45	3.36	1.26
	4	3.33	1.55	3.11	1.72	5.55	3.45	1.65
	6	3.37	1.62	3.25	1.84	5.80	3.52	2.08
	Mean	**3.28**	**1.53**	**3.07**	**1.72**	**5.54**	**3.41**	**1.54**
85	0	3.16	1.47	2.88	1.67	5.21	3.31	1.03
	2	3.31	1.53	2.98	1.71	5.34	3.42	1.08
	4	3.38	1.58	3.08	1.77	5.54	3.47	1.15
	6	3.45	1.60	3.21	1.79	5.76	3.48	1.34
		3.33	**1.55**	**3.04**	**1.74**	**5.46**	**3.42**	**1.15**
70	0	3.15	1.45	2.78	1.67	5.66	3.02	1.05
	2	3.22	1.51	2.85	1.68	5.68	3.14	1.08
	4	3.31	1.56	2.96	1.71	5.87	3.14	1.11
	6	3.33	1.57	3.06	1.77	5.88	3.23	1.28
	Mean	**3.25**	**1.52**	**2.91**	**1.71**	**5.77**	**3.13**	**1.13**
LSD5%	Water regime	**0.17**	**0.21**	**0.33**	**0.21**	**0.31**	**0.21**	**0.37**
	Glue	**0.11**	**0.14**	**0.16**	**0.13**	**0.27**	**0.18**	**0.29**
	Interaction	**Ns**	**0.06**	**0.08**	**0.04**	**0.17**	**0.14**	**0.21**

Results obtained by (Tognetti et al., 2003), who study the effect of irrigation system on root and white sugar beet yields, they found that yield of drip irrigated sugar beet with 70% of water requirement is nearly close to yield of sprinkler- irrigated sugar beet with 100% and they attributed that to highly efficient of drip irrigation than sprinkler system. Same results obtained by Hosseinpour et al. (2006), who added that water stress affecting to a certain extent all growth and productivity traits.

Macronutrient (N. P, K and Ca), chlorophyll A, chlorophyll b and Carotenoids% as affected by sprayed glue as soil conditioners on soil surface under different water regime (Table 3). Water relation at 70 % + 6% glue in spraying solution gained the highest value and the lowest ones were observed at untreated plot. According to the WR treatments effect on the Macronutrient (N. P, K and Ca), chlorophyll A, chlorophyll b and Carotenoids% of the sugar beet, data noticed that the reduction in the irrigation treatments was a combined with increase in sugar beet leaf content from N, P, K and Ca content. So, the highest values were recorded at WR 70%+6 % glue in spraying solution (N, 3.50 %), P (1.70%) and 100 WR (K, 3.25% and Ca (1.84%). Whereas, the lowest value was observed at WR 70 % +0% glue in same sequence.

Regarding to the effect of water regime treatments in sugar beet leaves, data pointed out that decrease amount of applied irrigation led to slightly increase (not significant) in the studied macronutrients, except at K and Ca which increase by 5 and 1.2 % . with respect to the glue effect on the macronutrients content

in leaf of the sugar beet (table 2), resulted data revealed that no clear trend was observed so, the changes was expressed in percentage as follows: 3.1, 2.1, 3.4, 1.6 – 5.2, 2.1, 7.0, 4.0 and 7.3, 2.1, 11.3, 8.0 % for N, P, K and Ca after spraying glue on the soil surface at concentration 2, 4; 6 % glue in spraying solution r compared with control. These results were in accordance with those obtained by (Abdallah et al., 2021.), who reported that glue is considered from poly ascarides and as they play an important role in bending between soil fine particles, it can absorb nutrients and decrease nutrient leaching from root zone
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Results in table 2 cleared those mean values of the chlorophyll A, B and carotenoids as affected by concentration of glue sprayed on soil surface under different water regime as percentage from ETo, data pointed out that the highest values of the chlorophyll A were close correlated with irrigation water deficiency and increase concentration of sprayed glue, while the opposite was true in case of the chlorophyll B and carotenoids content. The highest values of the chlorophyll A, B and carotenoids were attained at 70%WR+6% glue (5.88), 100%WR+6 % glue in spraying solution (3.525, 2.08) for chlorophyll A, B and carotenoids, respectively. Whereas, the lowest ones were recorded at 85%WR+control (5.21), 70%WR+control (3.02, 1.05) in same previous sequence. Regarding to the effect of the water regime treatments on the sugar beet leaves from chlorophyll A, B and carotenoids, data cleared that water regime treatment 85% scored the highest values for chlorophyll A, B and carotenoids, while the lowest ones were recorded at 70 %WR.

Regardless WR effect, data in Table 2 pointed out increase sprayed glue concentration enhanced content of chlorophyll A, B and carotenoids after 6 % glue in spraying solution and the lowest ones were obtained at control (untreated plot). The improvement in chlorophyll A, B and carotenoids were calculated in percentage as follow: 1.6, 2.9, 5.9 ; 4.6, 4.4, 21.1 and 7.6, 6.1, 45.5 % for 2, 4; 6 % glue in spraying solution comparing with control, respectively. This increasing in root weight is mainly due to not only to balanced fertilizers, but also to the role of soil moisture content on growth activity. The negative effects of reduced applied irrigation water on sugar beet yield and yield quality dovetail with those reported by Mahmoud et al (2012 and 2014). Additionally, Masri et al., (2015) found that drip irrigated sugar beet plants with 75% of water requirements recorded the highest significant leaf area extractable sugar% and other plant growth characters in both studied seasons.

SOIL PHYSICAL PROPERTIES

Data manifested in table 4 showed the effect of both studied factors on the hydraulic conductivity at saturated flow (HC) and aggregate percentage (dry sieving) at > 2 and < 2 mm. Data cleared that there is an enhancement in HC after spraying glue under different water regime treatment. The lowest values of the HC (preferable) were highly negative correlated with decrease applied irrigation water and increase glue concentration that obtained after 70 %WR and 6 % glue in spraying solution. Whereas, the highest values (highly drainable) were recorded at control treatment under 100 % WR followed by 85 % WR. With respect to the effect of the treatments on the HC values, data noticed that decrease applied water associated with reduction in HC, which calculated in percentage with values 5.6 and 8.6 % after 85 and 70 %WR comparing with 100 %WR, respectively. From the other side, glue concentration has a significant negative correlated with HC value and the reduction in HC was estimated in percentage with values 5.8, 12.9 and 18.9 % after 2, 4; 6 % glue in spraying solution.

Table (4) Effect of glue concentration on the hydraulic conductivity and aggregate percentage under different water regime after sugar beet crop.

Water regime %	Glue%/L	Hydraulic conductivity cm/h	Aggregate >2mm	Aggregate <2mm
100	0	20.20	11.17	88.83
	2	19.63	12.47	87.53
	4	18.37	13.40	86.60
	6	17.03	15.07	84.93
	Mean	**18.81**	**13.03**	**86.98**
85	0	19.40	12.32	87.68
	2	18.60	14.40	85.60
	4	17.17	15.53	84.47
	6	15.85	17.31	82.69
	Mean	**17.75**	**14.89**	**85.11**
70	0	19.73	12.85	87.15
	2	17.68	13.82	86.18
	4	16.12	13.94	86.06
	6	15.22	15.57	84.43
	Mean	**17.19**	**14.05**	**85.96**
LSD 5%	Water regime	**1.02**	**1.24**	**0.97**
	Glue	**0.93**	**1.02**	**0.81**
	Interaction	**0.71**	**0.83**	**0.68**

The mean values of the aggregate's percentage for > 2mm and < 2mm as affected by the investigated two factors (water regime and glue concentration) were illustrated in table 4. Data on hand revealed that increase glue concentration associated with decrease applied irrigation water (WR treatments) led to increase aggregates > 2mm and the opposite was true with aggregates < 2mm, where the highest aggregates > 2mm was recorded after 85 % WR followed by 100 with 6 % glue in spraying solution. Also WR 85 % has a superior effect on the aggregates > 2mm with percentage values 14.3 and 12.11 % comparing with 100 and 70 % WR, respectively. Additionally, data pointed out that increase glue concentration enhanced aggregates > 2mm with percentage value 2, 4 and 6 % glue in spraying solution, respectively. Resulted data agreed with those obtained by Abd El-Hady and Ebtisam (2016 a; b), they attributed the enhancement of the aggregates more than 2 mm to decrease soil evaporation and to dry-wet cycles that enhanced aggregates from side and soil ability to retain more water, especially under 70 and 85 WR treatments. They mentioned that there is a negative correlation between HC value and fine aggregates from side and soil ability to retain more water.

Another approach, the enhancement of soil pores and hence mean weight diameter mainly depends on soil particles size distribution, and glue act as a binding material that increase aggregates formation.
Also, results are in line with those obtained by (Abd El-Hady and Ebtisam, 2016 c) they found under coarse textured soils that application of natural conditioners greatly decreased the ability of soil to conduct water, such effect attributed to the modification of pore size distribution, decreasing the large pores (drainable pores), increasing the fine pores (water retention pores) and consequently reduced water flow rate. It could be summarized the some factors affecting the hydraulic conductivity of soil treated by protein

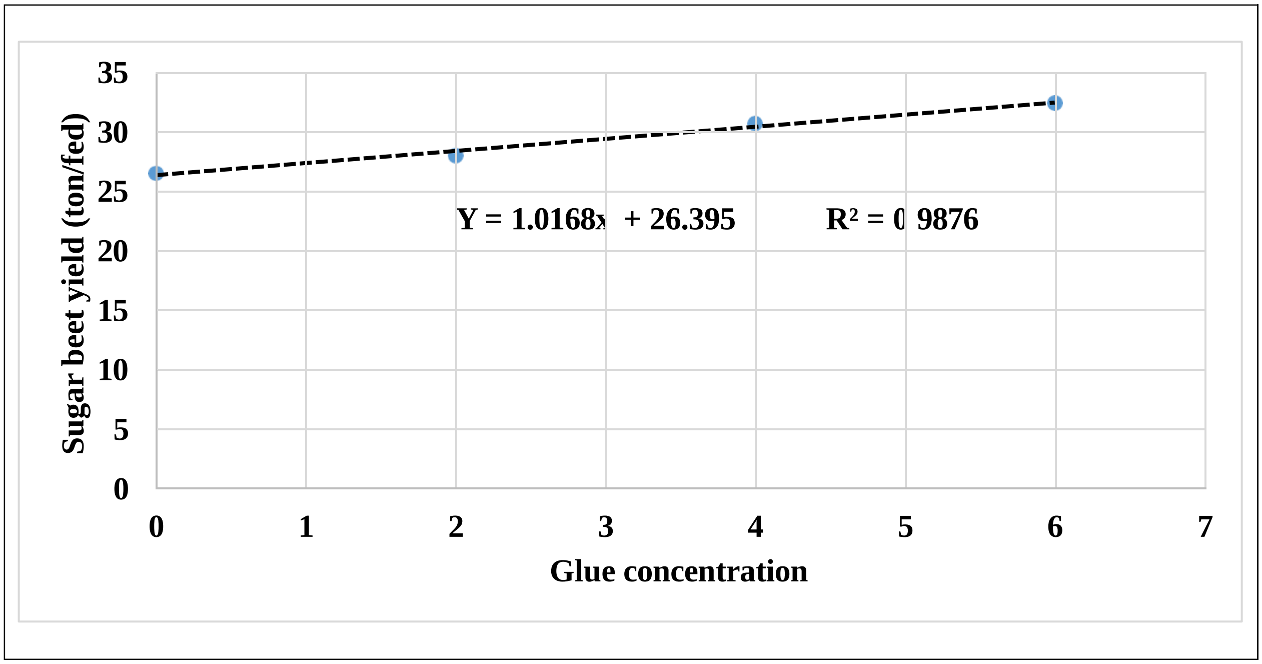
and poly saccharides to the its role in binding soil particles, redistribution of soil pores towards fine one that improve hydrophysical properties of the coarse textured soils. Finally, organic soil conditioners can improve not only the physical, chemical and biological properties of the soils due to its high contents of OM but also nutrients (e.g. N and P) for sustainable food production (Santos et al., 2014). Shinde et al., 2019 and Daniyan and Akhere, 2017) added that microorganisms can break down the organic wastes and transform them into organic compounds more useful for plant.

STATISTICAL ANALYSIS

*The obtained results indicated that sprayed glue on soil surface has a strongly positive correlation with all studied sugar beet growth and yield parameters such leaf area (0.658**), root weight (0.421*), root yield (0.447*), WUE (0.907**), and total sugar (0.516**). Also, data cleared that there is a positive significant relation between leaf area and root yield (0.845**) and total sugar (0.611*). Water regime positively correlated with both HC (0.433*) and aggregates >2mm (0.455**) and negatively with aggregates < 2mm (-0.454**). Whereas, glue negatively correlated with HC (-0.868**) and aggregates < 2mm (-0.823**) and positively with aggregates > 2mm (0.823**).*

*Also, glue has a highly significant positive correlation with chlorophyll A (0.700**), B (0.427**) and carotenoids (0.592**). The relation between sugar beet yield (ton/fed) and concentration of the sprayed glue to assess the close interaction (Fig. 1), regression equation was estimated and the equation is* ***Y = 1.0168x + 26.395 R² = 0.9876*****

*This result was supported with that obtained by ((Shinde et al., 2019). The investigated macro nutrient was highly positive correlated yield of sugar beet with r values 0.923**, 0.847** and 0.819** for N, K and Ca, respectively except P. Also, highly significant correlation was attained between WUE from side and chlorophyll A (0.904**) and B (0.785**), N (0.881**), P (0.919**) K (0.815**) and Ca (8485**).*



CONCLUSION

This experiment was carried out to assess water availability and maximize crop productivity from water use unit under water stress conditions. Water applied as a percentage of evapotranspiration (85 and 70 % of ET_o) as well as 100% as control one. Resulted data concluded that the soil physical properties (HC and aggregates) were improved due to water movement enhancement through redistribution of soil pores resulted after soil sprayed glue. Results concluded that improving performance under 70 and 85% of e-commerce opportunities could represent the best solution in the future, even so, the relative decrease in yields was related to the availability of water. Also, sugar beet yield of more than 20% under water pressure represent the best result especially, if the soil surface is treated with soil conditioners. So, reduce the loss of irrigation water from evaporation especially under the expected upcoming climate change scenarios. Sugar beet yields indicated that 85% and/ or 70% irrigation treatments, plants received suitable amounts of irrigation water under experimental conditions. The results showed a significant increase in root yield and total sugar yield by reducing irrigation water from 100% 85 to 75% ETo. Also, data cleared that sprayed soil by glue at 6g/liter enhanced most studied yield and yield paymasters due to save soil moisture from side and decrease evaporation from soil surface and decrease weeds account.

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