The effect of operational pressure on the fixed sprinkler irrigation system on barley plant growth vocabulary (*Hordeum vulgare* L.)

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Abstract .
A field experiment was conducted at the research station of the College of Agriculture / University of Basra at the site of Garmat Ali, during the growing season 2020-2021 in clay soil to study the effect of the operating pressure of the fixed sprinkler irrigation system, moisture depletion and the degree of soil softening on the growth vocabulary of barley (*Hordeum Vulgare* L.). Experiment coefficients, which include three main factors, were distributed in the Amelia experiment. The factors were the operating pressure factor, which includes three pressures, 150 kPa (P_1), 250 kPa (P_2) and 350 kPa (P_3), and the moisture depletion factor, which includes the depletion at 75% of ready water (M_1) and depletion at 50% of ready water (M_2), and the third factor is the soil softening factor by disc harrows, and it includes softening the soil after plowing once (C) and softening the soil three whet (S). The experiment's parameters were distributed in three replications, using a factorial experiment method using a randomized complete block design (R.C.B.D) for three replicates. The experimental units were planted with barley crop, where irrigation is carried out according to the moisture depletion of the ready water of the soil, in addition to the requirements for washing 20%. The results showed that increasing the operating pressure from P_1 to P_2 and then P_3 and the treatment of moisture depletion (M_1) and the treatment of soil with smoothing once (C) were the best results in increasing plant height, spike length, dry weight of the vegetative part and the highest grain yield compared with low operational pressures and treatment M_2 and soil softening treatment S

Key words: Irrigation by fixed sprinkler, moisture depletion, degree of soil softening, plant height, spike length, dry weight of the vegetative part, yield weight.
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Introduction

Water is one of the important natural resources that play a fundamental role in human, animal and plant life, and it is the main determinant of agricultural production, especially in arid and semi-arid areas, including Iraq, which depends mainly on irrigated agriculture. Sprinkler irrigation has a high water conveyance efficiency, and the efficiency of water use by sprinkler irrigation is about 70%, while it reaches 50-60% in surface irrigation in the best conditions, and the losses are more than 40%. (Al-Kubaisi, 2001).The main motive for the use of modern technologies in irrigation is the need to increase food production. Inability to choose an appropriate irrigation method exposes the construction of the soil to deterioration and deterioration of some of its physical properties such as soil crusting, low aggregate stability, water content, water movement in it, total porosity, increase in its apparent density and other physical characteristics (Jassim and others, 2009).Barley is the second crop after wheat among the grain crops in Iraq and the fourth in the world in terms of production and cultivated area. The economic importance of barley is concentrated in its use as a fodder and one of the components of healthy food. It is also used in other industries. The cultivation of barley (*Hordeum Vulgare* L.) is spread in the central regions And the South, as it gives high productivity in irrigated conditions (Al-Moaini, 2012).The increase in the operating pressure of the sprinkler irrigation system led to an increase in the grain yield and the plant height of the barley crop, where the grain yield reached (2.88, 3.82 and 4.98) ton ha^{-1} and (41.45, 48.87 and 57.14) cm, respectively, for the operating pressures of the system (200, 250 and 300) kPa, respectively (Abd El-Wahed *et al.,* 2016).Deficient irrigation is one of the processes of using less water than required for optimal plant growth and has many advantages, including reducing water consumption, improving plant response to water deficit, and increasing crop water productivity (Li *et al.,* 2019).The use of soil softening equipment after the plowing process is a primary objective of fraction, fraction and softening large soil aggregates and providing a suitable bed for the seed bed as well as burying crop and bush residues, which helps in creating suitable conditions for seed germination. Therefore, attention should be paid to the smoothing process, by choosing the appropriate machine, the speed of the front puller, and the number of smoothing times. The smoothing process has an effective role in improving the physical and water properties of the soil, in addition to affecting the horizontal and vertical movement of water in the soil body (Jassim and Saadoun, 2016).Ahmed *et al.* (2018) found the effect of the frequency of smoothing on the percentage of emergence of the sunflower crop and the bean crop, and the average values were (61.55, 79.22, 71.00 and 67.11)% for the sunflower crop and (59.11, 82.11, 69.77 and 69.11)% for the bean crop and the treatments Without softening and softening once and softening twice and softening three times in a row.

In order to address the problem of water scarcity, reduce irrigation water loss and maintain a good soil structure, and for the lack of studies of sprinkler irrigation in the southern region of Iraq, this study was conducted and its most important objectives are, the effect of the interaction between operating pressure, moisture depletion and soil softening on the vocabulary of barley yield growth in the soil clay.

Materials and working methods

A field experiment was conducted at the research station of the College of Agriculture - University of Basra in Karmat Ali site in Basrah governorate for growing barley (*Hordeum vulgare* L.) during the growing season 2020-2021 in clayey soil categorized as Clayey mixed, calcareous hyperthermic typic torrifluvent (Al-Atab, 2008).The results in Table (1) show some physical and chemical properties of the soil of the study area that were estimated according to the methods described in (Black *et al.,*1965)and (Page *et al.,*1982).

Table (1) Some initial physical, mechanical and chemical properties of soil, depths (0-15), (15-30), (30-45) cm, and salinity of irrigation water during plant growth stages

soil depth cm			Units	Properties
(30-45)	(15-30)	(0-15)		
123.453	137.324	172.657	g kg^{-1}	Sand
327.026	317.746	316.513		Silt
549.521	544.930	510.830		Clay

Clay	Clay	Clay	———	Texture
2.623	2.623	2.621	Mg m^{-3}	Particle density
1.343	1.321	1.299	Mg m^{-3}	Bulk density
48.799	49.637	50.438	%	Total porosity
53.320	56.500	54.230	%	Moisture when saturated
33.569	34.985	32.876	%	Field capacity
1.810	3.260	5.935	g kg^{-1}	Organic matter
293.365	310.29	326.815	g kg^{-1}	Total carbonate
28.410	29.105	28.355	Cmol kg^{-1}	CEC
29.255	29.170	25.130	$mmol^{-1}$	Ca^{++}
21.520	23.130	21.715	$mmol^{-1}$	Mg^{++}
1.575	1.745	1.340	$mmol^{-1}$	K^{+}
70.050	67.175	60.010	$mmol^{-1}$	Na^{+}
1.095	1.225	1.340	$mmol^{-1}$	HCO_3^{-}
154.030	135.425	109.675	$mmol^{-1}$	Cl^{-}
22.753	19.691	17.913	$mmol^{-1}$	SO_4^{--}
20.155	18.720	18.670	dS m^{-1}	EC_e
7.654	7.450	7.470	———	pH
The end of the growing season	middle of the growing season	Beginning of the growing season	dS m^{-1}	Irrigation water salinity
5.25	5.13	5.13		

The experiment was implemented using a randomized complete block design (R.C.B.D) with three replications. The experimental land was divided into three replicates, then the experimental land was divided into 36 experimental units between one experimental unit and another 1 m, and each experimental unit contained one sprinkler. treatment S), and the remaining 18 experimental units were left softened once (coarse soil C treatment). After completing the preparation of the field, the field was planted with barley seeds of a local variety on 1/12/2020. The experiment field was irrigated by fixed sprinkler irrigation with a quantity of water equal to 100% of the value of the field capacity, with the addition of 20% of the irrigation water as washing requirements. The amount of irrigation water to be added was calculated until the seeds were germinated, then the field was irrigated according to the soil moisture depletion factor, and after (134) days from the date of planting, the harvest was completed on 12/4/2021. Irrigation water was added to each experimental unit when its moisture content reached 75 and 50% of the total ready water, as random samples are taken from the experimental units to monitor the decrease in moisture content gradually after irrigation, and soil samples are taken before each irrigation so that water is added to restore The moisture content of the soil to the limits of field capacity by applying the mathematical equation referred to in (USAID-Inma, 2012):-

$$W = A \times \frac{\rho b}{\rho w} \times \left\{ \left(\frac{pwf.c}{100} - \frac{pww.p}{100} \right) \times \text{moisture depletion} \right\} \times D \ldots (1)$$

Where is:

W: the volume of water to be added to the experimental unit (m^3). **A**: The area of the experimental unit (m^2). **Pwf.c**: moisture content at field amplitude (w/w). **Pww.p**: soil moisture content at permanent wilting point (w/w). **ρb**:

the bulk density of the soil (mcg m^3). **ρw**: the density of water (mcg m^3). **D**: The depth of the soil to be moistened is 30 cm.

The time required to operate the sprinkler irrigation system for each experimental unit was calculated using the following equation (Hajem and Yassin, 1992):

$$T = \frac{W}{Q} \quad \dots (2)$$

Where is:

T: watering time (hours). **W**: volume of water added to the experimental unit (liters).**Q**: Sprinkler drainage (l $hour^{-1}$).

The plant growth terms were measured at the end of the growing season (after harvest) and included, the plant height was measured by a graduated ruler from the soil surface level to the spike base of the main stem and was randomly taken from each experimental unit.The length of the spike was measured from a random sample of each experimental unit and by means of a graduated ruler and from the base of the spike to the end of the spike without the spur. The dry weight of the plant was carried out, as samples were collected from the barley crop at the end of the growing season using a square of 1 m^2 area for three spaces for each experimental unit. The plants were cut from the place where they came into contact with the surface of the soil and then dried in the oven at a temperature of 70 °C until the weight was stabilized, and the weight was changed to a unit kg ha^{-1}. The grain yield was measured as the grains were separated from the ears, cleaned of impurities, and weighed and weighed in kg ha^{-1}.

The data was statistically analyzed using the statistical program Genstat DE10.3 for the year 2010 to analyze the variance between the treatments, their interactions and their differences, and the F-test and the value of the least significant difference, the RLSD average at the 0.05 level, were used to compare the means (Al-Mashhadani and Al-Qassab, 2017).

Results and discussion

1. Plant height

The results show in Fig.(1) that there was a significant effect of the operating pressure factor on the barley plant height values at the end of the growing season. As there are significant differences between all the operational pressure parameters, as the plant height increases with increasing operating pressure from P_1 to P_2 and then P3, as the pressure P_3 is superior to the rest of the operational pressures P_1 and P_2 with an increase of 9.699 and 5.129%, increasing the sprinkler pressure led to a decrease The size of the water droplets leaving the sprinkler, which reduced the impact of the impact force of water droplets on the surface of the soil, which reduced the possibility of a thick surface crust, which reduced the processes of crushing and collapse of soil assemblies, which preserved the construction of the soil, in addition to increasing the water infiltration, increasing the moisture content and reducing salinity. From the effort exerted by the plant to absorb water, which increased the growth of the plant (Abd El-Wahed et al., 2016). The results in Fig.(1) showed a significant effect of the moisture depletion factor on the height values of barley plant at the end of the growing season. The moisture depletion coefficient M_1 was significantly superior to the increase in plant height by 8.003% compared with the moisture depletion M_2, due to keeping the soil within moisture limits close to the field capacity in addition to the close irrigation periods, which led to an increase in the moisture content in the soil, which in turn reduced the salinity of the soil And pushing it to the depths, thus reducing the effort exerted by the plant to absorb water, which increased the growth of the plant (Zhang *et al*., 2021).It is show from Fig.(1) that there is a significant effect of the degree of soil softening factor in the values of barley plant height at the end of the growing season. As the treatment of the degree of softening of the soil once, C, was superior to it by giving it the highest value for plant height compared to treatment S, and the rise rate was 11.370%. Water, increased moisture content and reduced soil salinity, which reduced the osmotic moisture tension in the studied area, which was positively reflected in plant growth and height (Al-Mohammadi, 2013).

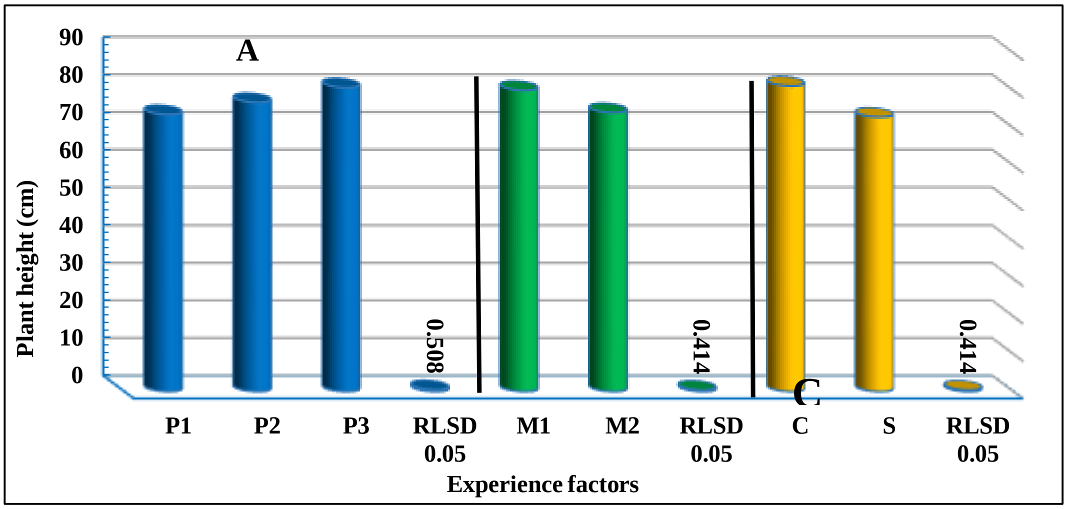

Fig.(1) Effect of experimental factors on plant height (cm) at the end of the growing season (A: operating pressure, B: moisture depletion and C: and degree of soil softening)

B

The results in Fig.(2) show a significant effect of the interaction of the factors of operating pressure and moisture depletion on the height values of barley plant at the end of the growing season. It is clear from the figure that the significant increase in plant height values with increasing operating pressure varies according to the moisture depletion factors used, and that the differences between P_3, P_2 and P_1 appeared higher than M_2 compared to M_1 and this is due to the role of increasing moisture content at M_1, which reduced the negative impact The decrease in the operating pressure in the plant height values, as well as the increase in the efficiency of salt washing with depth by increasing the moisture content at M_1, which increases with increasing operating pressure and is reinforced by the increase in the moisture content added for treatment M_1 compared to M_2 (Attafy *et al.,* 2017).

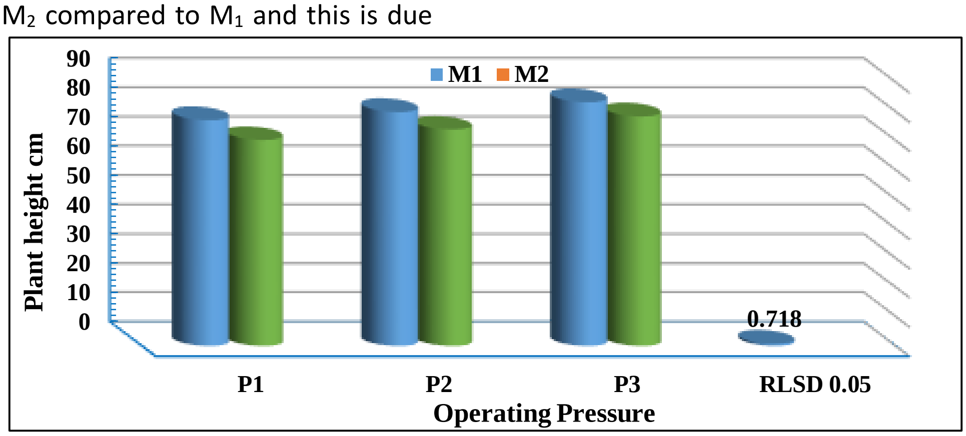

Fig.(2) The effect of the interaction between operating pressure and moisture depletion factors on plant height values (cm) at the end of the growing season

The results in Fig.(3) show a significant effect of the interaction of the two factors of moisture depletion and the degree of soil softening on the plant height values at the end of the growing season. A significant increase in plant height values is observed with the different moisture depletion coefficients M_1 compared to M_2 and it varies according to the different degrees of soil softening for treatment C compared to treatment S in plant height values, as the treatment M_1 and the low soil softening treatment C led to an increase in the moisture content in the body The soil, which led to a decrease in the salt content in the soil, in addition to an increase in the average weighted diameter, which led to a decrease in the bulk density and an increase in the total porosity of the soil, which led to the formation of suitable air and moisture conditions that positively reflected on plant growth (Ahmed *et al*., 2018).

There was no significant effect of the three interaction between the main factors on plant height values at the end of the growing season.Table (2) shows the triple interaction between the operating pressure factor, moisture depletion and the degree of soil softening in the plant height values at the end of the season. As the transaction P_3M_1C recorded the highest value of 86,670 cm, while the transaction P_1M_2S recorded the lowest value of 66,000 cm.

Table (2) The three interaction between the operating pressure factor, moisture depletion and the degree of soil softening in the values of plant height (cm) at the end of the growing season

Operating pressure	Moisture depletion	degree of soil softening	
		C	S
P_1	M_1	81.110	73.000
	M_2	74.330	66.000
P_2	M_1	83.780	75.890
	M_2	78.330	69.220
P_3	M_1	86.670	79.670
	M_2	83.000	73.670
RLSD0.05		NS	

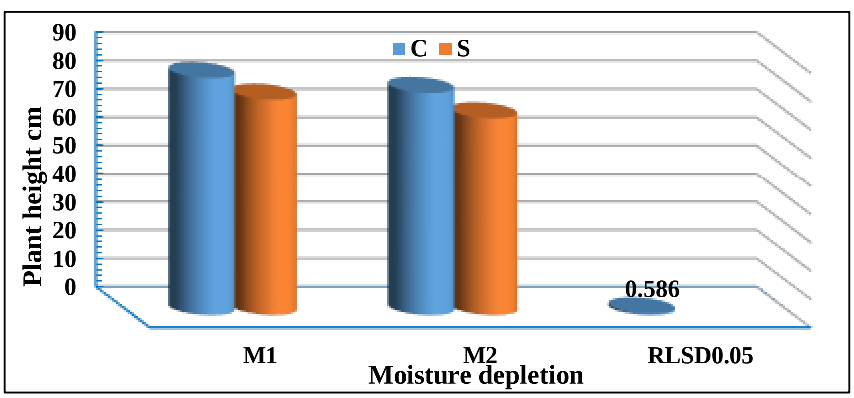

Fig.(3) The effect of the interaction between the two factors of moisture depletion and the degree of soil softening on the values of plant height (cm) at the end of the growing season

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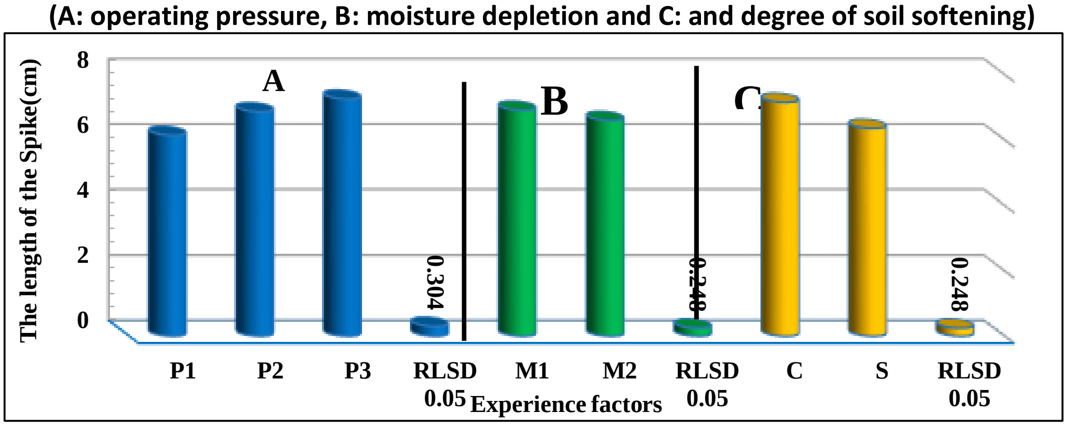
. The length of the spike

The results in Fig.(4) show that there is a significant effect of the operating pressure factor on the spike length values of barley at the end of the growing season. The results showed that there was a significant increase in the spike length values by increasing the operating pressure, as the pressure P_3 was superior to the rest of the operating pressures P_1 and P_2, with an increase of 18.097 and 5.669%, due to the aforementioned reasons related to improving soil construction, increasing water tip, moisture content and increasing washing The salts increased by increasing the operational pressure, which provided suitable conditions to increase the growth of the vegetative plant and this was reflected in the length of the spikes, as the increase in the sprinkler pressure led to a decrease in the size of the water droplets leaving the sprinkler, which led to a reduction in the impact of the force of the collision of water droplets on the soil surface, which reduced the possibility of a surface crust thick, which reduced the processes of crushing and collapse of soil aggregates (Kassem, 2009). The results in Fig.(4) showed a significant effect of moisture depletion factor on spike length values of barley crop at the end of the growing season. The moisture depletion coefficient M_1 was significantly superior to the increase in spike length by 4.762% compared to the moisture depletion M_2, due to keeping the soil within moisture limits close to the field capacity in addition to the close irrigation periods, which led to an increase in the moisture content in the soil, which in turn reduced the salinity of the soil And pushing it to the depths, thus reducing the effort exerted by the plant to absorb water, which increased the growth of the plant (Zhang *et al.,* 2021).It is show from Fig.(4) that there is a significant effect of the Soil softening degree factor on the spike length values of barley crop at the end of the growing season. The one-time soil softening treatment C was superior to C by giving it the highest value of the spike length compared with treatment S, and the increase was 12.531%. Treatment C compared to treatment S, as well as due to the increase in the number of times of passage of agricultural machinery and equipment in the field, which leads to the destruction of large soil masses and the crushing of soil aggregates, which led to a decrease in the moisture content of the soil, which was negatively reflected on the length of the spike (Al-Mohammadi, 2013).

Fig.(4) Effect of experimental factors on The length of the spike(cm) at the end of the growing season (A: operating pressure, B: moisture depletion and C: and degree of soil softening)



There was no significant effect of the dual and three interactions on the spike length values at the end of the growing season. Table (3) shows the triple interaction of the operating pressure factor, moisture depletion and the degree of soil softening in the spike length values at the end of the growing season. The treatment P3M1C recorded the highest value of 7.778 cm, while the treatment P1M2S recorded the lowest value of 5.667 cm.

Table(3) The triple interaction between the operating pressure factor, moisture depletion and the degree of soil softening in the values of The length of the spike(cm)

Operating pressure	Moisture depletion	degree of soil softening	
		C	S
P_1	M_1	6.778	5.778
	M_2	6.333	5.667
P_2	M_1	7.444	6.444
	M_2	7.111	6.444
P_3	M_1	7.778	7.222
	M_2	7.444	6.556
RLSD0.05		NS	

3. Dry weight of the vegetative part

The results in Fig.(5) show a significant effect of the operating pressure factor on the dry weight values of the vegetative part of the plant at the end of the growing season. The results showed that there was a significant increase in the values of dry weight by increasing the operating pressure, as the pressure P_3 outperformed compared to the rest of the operating pressures P_1 and P_2 with an increase of 34.338 and 7.925%, and this is due to the aforementioned reasons related to maintaining the physical and water properties of the soil through increasing the efficiency Salt washing and reducing them in the soil sector, which was positively reflected on the dry weight of the vegetative part of the plant (Kassem, 2009).The results in Fig.(5) showed a significant effect of the moisture depletion factor on the dry weight values of the vegetative part of the plant at the end of the growing season. The moisture depletion coefficient M_1 was significantly superior to the increase in the dry weight of the vegetative part by 24.481% compared to the moisture depletion M_2, and this is due to keeping the soil within moisture limits close to the field capacity due to the closeness of irrigation periods, which in turn reduced the negative effect of repeated wetting and drought processes, which leads to The occurrence of cracks in the soil and the destruction of soil aggregates at subsequent irrigations, and this is what happened when the moisture depletion M_2 (Zhang *et al.,*2021).It is evident from Fig.(5) that there is a significant effect of the degree of soil softening factor on the dry weight values of the vegetative part of the plant at the end of the growing season. One time soil softening treatment C was superior to C by giving it the highest value of dry weight compared with treatment S and the percentage increase was 44.356%, due to the increase in the number of times of passage of machines and agricultural machines in the field, which leads to the destruction of large soil blocks and the destruction of soil aggregates, which led to a decrease in the moisture content The soil and the increase of soil salinity as well as the indirect effects on the physical properties of the soil, which was negatively reflected on the dry weight of the plant (Attafy *et al.,* 2017).

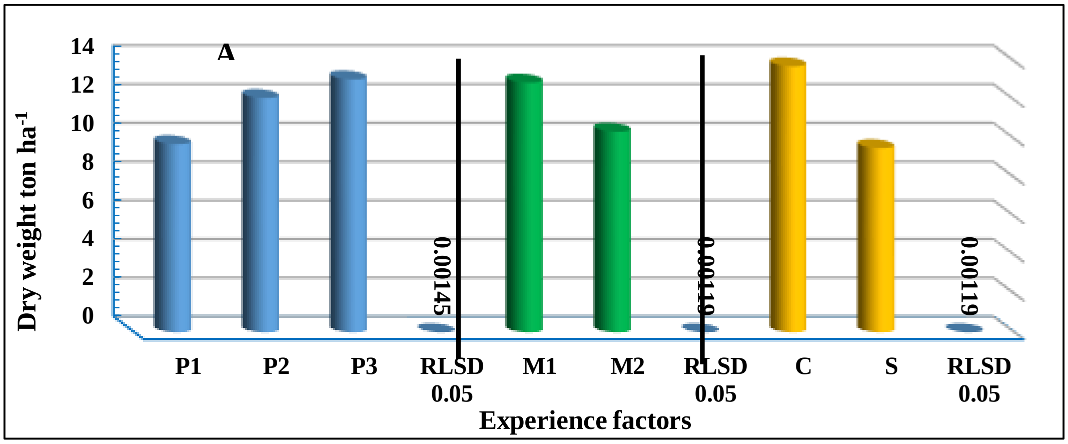
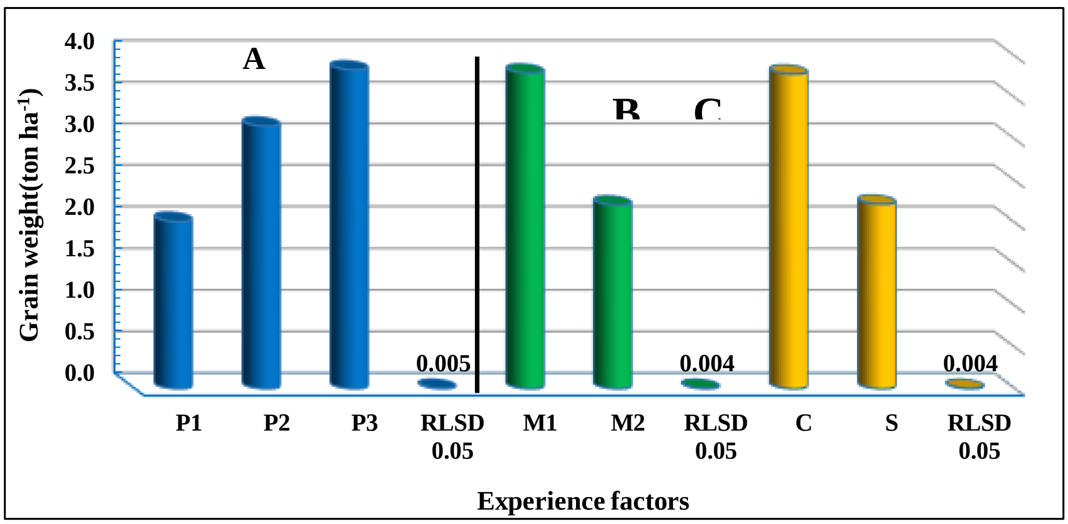


Fig.(5) The effect of the study factors on the values of dry weight of the vegetative part (ton ha^{-1}) at the end of the growing season (A: operating pressure, B: moisture depletion and C: and degree of soil softening)

Fig.(6) Effect of study factors on the values of grain weight (ton ha^{-1}) (A: operating pressure, B: moisture depletion, C: and degree of soil softening)



The results in Table (4) show a significant effect of the interaction of operating pressure and moisture depletion factors on the dry weight values of the vegetative part of the plant at the end of the growing season. As it is evident from the table that the significant increase in the values of dry weight of the vegetative part increases with increasing operational pressure and varies according to the moisture depletion factors used and that the differences between P_3, P_2 and P_1 appeared higher than M_2 compared to M_1 reinforced by increasing operational pressure in providing suitable conditions for plant growth from physical characteristics And water represented by the increase in the moisture content and the decrease in salts due to the increase in the efficiency of salt washing with depth by increasing the moisture content at M_1, which led to an improvement in soil construction at the end of the growing season, which increases by increasing the operational pressure and is reinforced by an increase in the moisture content added to the M_1 treatment compared to M_2.

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Table (4) The effect of the interaction of operating pressure and moisture depletion on the values of dry weight of the vegetative part (ton ha^{-1}) at the end of the growing season

Moisture depletion / Operating Pressure	M_1	M_2
P_1	11.614	7.829
P_2	13.225	10.975
P_3	13.845	12.273
RLSD0.05	0.002	

The results in Table (5) show a significant effect of the interaction of the two factors of operating pressure and the degree of soil softening on the dry weight values of the vegetative part of the plant at the end of the growing season. The increase in the dry weight values between the two degrees of smoothing C compared to S varies according to the variation in the operating pressure, and the highest differences between C and S appeared at the operating pressure P_1 and decreased by increasing the pressure to P_2 and then P_3 due to the increase in the operating pressure reduces the differences between C and S (Zapata *et al.,*2018).

Table (5) The effect of the interaction of the operating pressure and the degree of soil softening on the values of the dry weight of the vegetative part (ton ha^{-1}) at the end of the growing season

degree of soil softening / Operating Pressure	C	S
P_1	12.669	6.773
P_2	13.962	10.238
P_3	14.581	11.537
RLSD0.05	0.002	

The results in Table (6) show a significant effect of the interaction of the two factors of moisture depletion and the degree of soil softening on the dry weight values of the vegetative part of the plant at the end of the growing season. The highest variation between the levels of moisture depletion M_1 and M_2 was at the smoothing treatment S, while the lowest variation was at the treatment C. In general, the highest values of the dry weight of the vegetative part were at the moisture depletion M1 and treatment C compared with the moisture depletion M_2 and treatment S, where the values reached 14.290 and 7.533 tons ha^{-1}, due to the aforementioned reasons related to the shorter irrigation periods at M_1 led to an increase in moisture content, which reduced the collision energy of irrigation water droplets with the soil surface and increased the water tip in the soil body and the efficiency of salt washing, and this effect is enhanced by treatment C compared to treatment S, and here it can be concluded that Smoothing treatment C reduced the variance in dry weight by different moisture depletion treatment M_1 compared to M_2 as a growth determinant (Chen *et al.,* 2019).

Table (6) The effect of the interaction of moisture depletion factors and the degree of soil softening on the values of dry weight of the vegetative part (ton ha^{-1}) at the end of the growing season

degree of soil softening / Moisture depletion	C	S
M_1	14.290	11.500
M_2	13.185	7.533
RLSD0.05	0.001	

Table (7) shows that there is a significant effect of the three interaction between the coefficients of operating pressure, moisture depletion and the degree of soil softening on the dry weight values of the vegetative part at the end of the growing season. The table shows the effect of the above-mentioned study factors on the values of dry weight, where the treatment P_3M_1C recorded the highest value of dry weight, which amounted to 14.917 tons h^{-1}, and the lowest value amounted to 4.126 tons h^{-1} when the treatment P_1M_2S, where it is noted that the increase in the operational pressure and the degree of soil softening C reduced the effect of the depletion factor Moisture M_2 at the end of the growing season, as it led to an increase in the moisture content of the soil, a decrease in the bulk density and an increase in the water infiltration, which in turn led to a decrease in soil salinity and a washing of salts to the depths.

Table (7) The effect of the operating pressure factor, moisture depletion and the degree of soil softening on the values of dry weight of the vegetative part (ton ha^{-1}) at the end of the growing season

Operating pressure	Moisture depletion	degree of soil softening	
		C	S
P_1	M_1	13.807	9.421
	M_2	11.532	4.126
P_2	M_1	14.145	12.305
	M_2	13.780	8.171
P_3	M_1	14.917	12.773
	M_2	14.244	10.301
RLSD0.05		0.0029	

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4.Grain weight

The results in Fig.(6) show that there is a significant effect of the operating pressure factor on the values of the grain weight of the plant at the end of the growing season. The results showed that there was a significant increase in the values of grain weight by increasing the operating pressure, as the pressure P_3 outperformed compared to the rest of the operating pressures P_1 and P_2 with an increase of 90,651 and 21.444%. The effect of the force of the collision of water droplets on the surface of the soil, which reduced the possibility of the occurrence of a thick surface crust, which reduced the processes of crushing and collapse of soil assemblies, which preserved the construction of the soil in addition to increasing the water content and moisture content, which increased the movement of water and salts and the efficiency of their washing towards the depths, which increased the Vegetative growth and this was reflected on the weight of the grains, which was positively reflected on the weight of the grains (Kassem, 2009).The results in Fig.(6) show a significant effect of the moisture depletion factor on the values of grain weight of the plant at the end of the growing season. The results in the figure showed that the moisture depletion factor M_1 was significantly superior to the increase in grain weight by 72.030% compared to the moisture depletion M_2, and the reason for this is To keep the soil with moisture limits close to the field capacity as well as to provide suitable conditions represented by physical and water characteristics and reduce soil salinity, which encouraged vegetative growth, which was positively reflected in the grain yield (Zhang *et al.,*2021). The show from Fig.(6) that there is a significant effect of the degree of soil softening factor on the values of the grain weight of the plant at the end of the growing season. The superiority of the soil softening treatment once C recorded the highest value of grain weight compared with treatment S and the percentage increase was 70.681%. Favorable conditions to increase the vegetative growth of the plant, which was reflected in the grain yield (Attafy *et al.,* 2017).

The results in Table (8) show a significant effect of the interaction of operating pressure and moisture depletion factors on the grain weight values. It is clear from the table that the significant increase in the values of grain weight by increasing the operating pressure varies according to the moisture depletion factors used, and that the differences between P_3, P_2 and P_1 appeared higher at M^1 compared with M_2, and this is due to the role of increasing the moisture content at M_1, reinforced by increasing the operational pressure And its effect in providing suitable conditions for vegetative growth and increasing grain yield by providing plant and water moisture and low moisture tension (Attafy *et al.,* 2017).

Table (8) Effect of operational pressure and moisture depletion factors on grain weight values (ton ha^{-1})

Moisture depletion / Operating Pressure	M_1	M_2
P_1	2.486	1.535
P_2	4.054	2.261
P_3	4.846	2.822
RLSD0.05	0.008	

The show from Table (9) that there is a significant effect of the interaction of the two factors of operating pressure and the degree of soil softening on the values of grain weight. The increase in grain weight values with increasing operating pressure varies according to the softening degree treatment and the highest variations in grain weight values from P_3, P_2 and P_1 appeared at treatment C compared to its counterparts from treatment S, and this is due to the increase in operating pressure enhanced by increasing soil moisture content for the above reasons The mentions related to reducing the collision energy of irrigation water droplets with the soil surface, increasing the water infiltration and increasing the efficiency of salt washing to the depths. Whereas, the P_1C transaction recorded the highest value, amounting to 4.900 ton ha^{-1}, and the lowest value recorded by the P_1S transaction, which amounted to 1.440 ton ha^{-1} (Eid *et al.,*2019).

Table (9): The effect of operating pressure factors and soil softening degrees on the values of grain weight (ton ha^{-1})

degree of soil softening / Operating Pressure	C	S
P_1	2.581	1.440
P_2	3.871	2.443
P_3	4.900	2.767
RLSD0.05	0.008	

The results in Table (10) show a significant effect of the interaction of the two factors of moisture depletion and the degree of soil softening on the grain weight values. The table shows the highest variance between the levels of moisture depletion at the smoothing treatment C, while the lowest variance was at the treatment S. In general, the highest values were at the moisture depletion M1 and treatment C compared with the moisture depletion M_2 and treatment S, where the values reached 4.654 and 1.498 ton ha^{-1}, due to For the aforementioned reasons related to the shorter irrigation periods at M_1 led to an increase in the moisture content, which reduced the collision energy of irrigation water droplets on the soil surface and increased the water infiltration in the soil body, which increased the efficiency of salt washing, as well as the decrease in the number of times of passage of agricultural machines and machines, and this effect is enhanced by treatment C compared to treatment S. (Ahmed *et al.,* 2018).

Table (10) Effect of moisture depletion coefficients and degree of soil softening on grain weight values (ton ha^{-1})

degree of soil softening / Moisture depletion	C	S
M_1	4.654	2.936
M_2	2.914	1.498
RLSD0.05	0.006	

Table (11) shows that there is a significant effect of the three interaction between the coefficients of operating pressure, moisture depletion and the degree of soil softening on the values of grain weight. As the treatment P_3M_1C recorded the highest value of grain weight, which amounted to 5.933 tons ha-1, and the lowest value amounted to 1.134 ton ha^{-1}, when the treatment P_1M_2S, it is noted that the increase in the operational pressure and the degree of soil softening C reduced the effect of the moisture depletion factor M_2 at the end of the growing season, as it led to an increase The moisture content of the soil, the decrease in the bulk density and the increase in the water infiltration, which in turn led to the reduction of soil salinity and the washing of salts to the depths (Al-Mousawi and AbdelKarem, 2016).

Table (11) The effect of the operating pressure factor, moisture depletion and the degree of soil softening on the values of grain weight (ton ha^{-1})

Operating pressure	Moisture depletion	degree of soil softening	
		C	S
P_1	M_1	3.226	1.747

	M_2	1.936	1.134
P_2	M_1	4.804	3.304
	M_2	2.939	1.583
P_3	M_1	5.933	3.759
	M_2	3.868	1.776
RLSD0.05		0.011	

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