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The effect of salicylic spraying and planting distances on certain Physiological and Yield traits of Oats (*Avena sativa* L.)

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ABSTRACT

A field experiment was conducted at the Research Station of the Field Crop Department College of Agriculture – Tikrit University, Saladin Governorate for the winter season 2022-2023 to study the effect of spraying at different levels of concentrations of salicylic acid and planting at various distances of Oat crops on some of the characteristics of Physiological and vegetative growth and yield. The experiment was carried out using a factorial random complete block design with three replicants in two factors, the first is spraying the salicylic growth regulator with three concentrations (0, 75, and 150) mg L⁻¹. The second factor included distances between the planting rows (10 and 20 cm), the results showed an improvement in the level of concentration of salicylic 100 mg L⁻¹ Compared with the rest of the salicylic concentration levels in the quality of duration of dry matter production (Biomass duration) and the absolute growth rate, the number of grains in panicle and the weight of a thousand oats grain trait, the distance (spacing) factor between the planting rows 20 cm improved compared with 10 cm planting spaces in all qualities studied in the experiment. As for the Interaction between the two factors of the experiment, the concentration recorded 100 mg L⁻¹ and the distance between the planting rows was 20 cm high significant differences from the rest concentration levels of the regulator (salicylic) and row planting distances.

تأثير الرش بالسالسليك ومسافات الزراعة على بعض الصفات الفسلجية والحاصل للشوفان

Avena sativa L

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قسم المحاصيل الحقلية، كلية الزراعة، جامعة تكريت، العراق

الخلاصة

اجريت تجربة حقلية في محطة أبحاث قسم المحاصيل الحقلية التابع لكلية الزراعة، جامعة تكريت محافظة صلاح الدين للموسم الشتوي ٢٠٢٢-٢٠٢٣ بهدف دراسة تأثير الرش بمستويات مختلفة التركيز من حامض السالسليك والزراعة بمسافات مختلفة لمحصول الشوفان على بعض الصفات الفسلجية للنمو والحاصل نفذت التجربة عاملية بنظام تصميم القطاعات العشوائية الكاملة Factorial experiment بثلاث مكررات في عاملين، الاول رش منظم النمو السالسليك بثلاث مستويات (٠ و ٧٥ و ١٥٠) ملغم لتر-١. والعامل الثاني ضم مسافات بين خطوط الزراعة (١٠ و ٢٠) سم، اظهرت النتائج تفوق مستوى تركيز السالسليك ١٠٠ ملغم لتر-١ على باقي مستويات تركيز منظم النمو في صفة مدة بقاء انتاج المادة الجافة ومعدل النمو المطلق عدد

الحبوب في الدالية وصفة وزن ألف حبة لنباتات الشوفان، كذلك تفوق عامل المسافة بين خطوط الزراعة ٢٠ سم على الزراعة بمسافات ١٠ سم في جميع الصفات التي تم دراستها في التجربة. اما عن التداخل بين عاملي التجربة فقد سجل التركيز ١٠٠ ملغم لتر-١ والمسافة بين خطوط الزراعة ٢٠ سم فروق عالية المعنوية عن باقي مستويات تركيز المنظم (السالسليك) ومسافات الزراعة.

الكلمات المفتاحية: الشوفان، حامض السالسليك، مسافات الزراعة، معدل النمو المطلق، الحاصل.

INTRODUCTION

Oat (*Avena sativa* L.). An herbaceous plant belonging to the Poaceae family, it has several names, including xiwan or Hertuman, the grains used in human nutrition it is presented as chips or flour and also baked oatmeal biscuits when adding wheat flour because oats are not suitable for baking. It is used for animal feeds, and its hay is sometimes used as floor covering. The Mediterranean region is the original home of oats and has been transported to cold, humid areas such as Northern Europe, northern United States, southern Canada (Murphy and Hoffman, 1992) and (Rines et al., 2006). Russia is the top producer, followed by the United States, Canada, and Australia. Oats have nutritional value; every 100 grams of cereal contains 65.27% carbohydrates, 10.61% fiber, 6.2% fat, and 15.89% protein. (USDA, 2018). As well as containing amino acids such as arginine, tryptophan, and vitamins such as vitamin B1. Salicylic acid is the chemical formula $C_6H_4(OH)COOH$. It is also known as 2-hydroxybenzene carboxylic acid (front matter, 2013). It is an essential antioxidant for improving the plant's defense system and increasing the activity of some important antioxidant enzymes, as spraying it on the plant is important in several phyletic processes including ion absorption, nutrient metabolism, photosynthesis, and follicle opening control (Kumar, 2010), and salicylic is a growth hormone produced within the plant from cinnamic acid (ANOU, 2011). Oats tolerate agriculture in relatively weak soils and more acidic soils than wheat and barley crops (Al-Taher, 1999), to raise the yield of the crop, attention should be paid to some agricultural processes, including the selection of appropriate distances between the planting lines to ensure the reduction of competition between plants for the basic sources of growth and production and affect the Physiological processes of the plant of soil, water and light elements and ensure the appropriate distribution of seeding rate per unit area.

MATERIALS AND METHODS

A field experiment was carried out in October 2022 to indicate the best level of salicylic spraying on the vegetative part the planting distances between the rows (lines) and their impact on the growth of the oat crop, by designing the complete random sectors RCB arrangement of factorial experiments of the first two levels of salicylic concentrations acid (0, 50 and 100) amalgam L-1, which was added to the vegetable part at a stage of formation of 2-3 leaves of the plant and the second spaces between the lines of oat cultivation (10 and 20) cm, the seeds were planted at the rate of 120 kg -1 in 6 rows (lines) of the experimental unit length 2 m after conducting orthogonal tillage and smoothing of the soil which was 13% gypsum and 7.8 of Ph of a structure sandy loam soil, nitrogen fertilizer (Urea) was added twice at the rate of (200) kg h-1 and (100) kg h-1 superphosphate and potassium sulfate (80) kg h-1. The biomass duration, which is useful for obtaining the value of the dry matter in time, is calculated from the Hunt equation (1982).

$$B.M.D = (T_2 - T_1) (W_2 + W_1) / 2$$

The absolute growth rate trait which refers to the rate at which a crop or plant grows was calculated and estimated from the Hunt equation (1982).

$$AGR = (W_2 - W_1) / (T_2 - T_1)$$

W1, and W2 dry plant weight in time T2 and T1 respectively .

10 plants were taken from the middle lines of the experiment units and the average number of grains in the panicle was recorded after harvest. By weighing 1000 grains from each experimental unit using a sensitive scale, collected experiment data was analyzed according to the design used in the experiment using the Minitab analyzing program, and the Duncan test of averages was compared using the.

RESULT AND DISCUSSION

1- Biomass duration (G measurement duration⁻¹).

Results of Table (1) indicate that oat plants treated with a salicylic concentration of 100 mg L⁻¹ in terms of the duration of production of dry matter over the rest of the concentrations applied in the experiment with an average of 267.8 g measurement duration⁻¹ than the lowest average of the control treatment (without spraying), which recorded an average of 179.2 g measurement duration⁻¹ with a difference of 49.44%. This may be due to the effect of the concentration of salicylic which encourages cell division (Mohammed, 2003), as well as its role in regulating the action of nitrate-reducing with sugar-carrying enzymes. Its role of increase the number of leaves and branches and dry weight of the vegetable total (Sohair, 2006), which is reflected in the increase in plant growth and thus increase in dry weight and the duration of its production (Kaydan et al. 2007), and its effect on the growth of the root and vegetable total and these results are indicated by Magghsoudik, Arvin (2010), Vicente and Plasencia (2011) as well as inhibiting the formation of ethylene leading to plant aging, salicylic acid has an important role in raising the efficiency of the carbon-building process and increasing the concentration of hormones such as cytokines, Gibberellins and Auxins (Yanova, 2010) and the role of salicylic in promoting the growth of the radical sum (Sarhan, 2014).

The statistical analysis results in the same table for the duration of dry matter production for oat crop plants show significant differences between the parameters of the planting distances as the highest average distance of 20 cm between the planting lines was 248.3 g measurement duration⁻¹ for the spaces 10 cm, which recorded an average of 205.5 g duration measurement⁻¹ by a difference of 20.82%. this increase might be due to the lack of competition between oat plants when planting at more appropriate distances to reduce competition for light and water and the basic need to increase the representative activity of increasing organic materials such as proteins, and carbohydrates, to continue to increase the dry matter of the plant and its duration. Also, the plants planted at small distances get a large amount of sun shade, which leads to a decrease in the number of branches and leaf area and a reduction in the efficiency of carbon representation and thus a decrease in the biological output of the plant, unlike plants planted at large distances, where the plant can obtain most of its needs of nutrients light, and thus an increase in the number of branches and leaf area, an increase in carbon efficiency and plant growth rate and therefore an increase in the biological output of the plant (Cardiner et al., 1990). This is consistent with Dalip et al. (1998) and Al-Dulaimi (2003), who pointed to the increase in the biological quotient of the plant by increasing the distance between the lines.

Table (1) shows the existence of a significant difference in the Interaction between the two factors of the concentration of the growth regulator and the distances of planting, where the interference recorded 100 mg L⁻¹ and the distance between the planting lines 20 cm the highest average grade was 296.434 G measurement duration⁻¹ than the lowest average recorded by the control treatment of salicylic and the distance 10 cm between the planting lines by 77.19%. of difference.

Table 1: Effect of salicylic concentration and planting distances on Biomass duration. (G measurement duration⁻¹).

Salicylic level (Mg L ⁻¹)	Seeding spaces (cm)		
	10	20	Mean
0	167.290 f	191.000 e	179.2 c
50	210.000 d	257.382 b	233.7 b
100	239.140 c	296.434 a	267.8 a
Mean	205.5 b	248.3 a	

2- The Absolute growth rate (mg day⁻¹):

The results of Table (2) indicate that oat plants treated with salicylic at a concentration of 100 mg L⁻¹ in the absolute growth rate characteristic over the rest of the regulator concentration applied in the experiment with an average of 0.07340 mg per day⁻¹ compared with the lowest average control treatment (without spraying), which was with an average of 0.04568 mg day⁻¹, an increase of 60.68%. It may be due to the action of the concentration of salicylic and its encouragement of cell division, its positive effect of salicylic in the quality of the duration of the production of dry matter, and its role in increasing the leaves number and branches, dry weight of the vegetable total (Sohair, 2006), which is reflected in the increase of the plant growth and then increase of dry weight and the duration of production (Kaydan et al, 2007), salicylic acid has an important role in raising the efficiency of the carbon-building process and increasing the concentration of hormones such as cytokines, Gibberellins and Auxins (Yanova, 2010) and the role of salicylic in promoting the growth of the root total (Sarhan, 2014). The statistical analysis results in table (2) of absolute growth rate indicate to significant differences between the parameters of the planting distances as the highest average distance of 20 cm between the planting lines was 0.06714 mg day⁻¹ for the distance 10 cm, which shows an average of 0.05384 mg day⁻¹ with 24.7%, of difference, the reason for this increase is the low level of competition between oat plants when planting at more appropriate distances to reduce competition for light and water and the basic needs to increase the representative activity of building organic materials such as proteins, carbohydrates, etc. to continue to increase the dry matter of the plant and to continue to increase it with the availability of suitable environment for growth, which increases the efficiency of the Physiological processes essential for the biological construction processes in plants, Table (2) shows that there is a significant difference in relation to the Interaction between the growth regulator concentration factors and the cultivation distances, where the Interaction was 100 mg L⁻¹ and the distance between the planting lines 20 cm higher average grade of 0.08236 mg day⁻¹ than the lowest average recorded by the interference in comparison treatment (control) for salicylic and the distance of 10 cm between the planting lines which obtain an average of 0.04189 mg day⁻¹.

Table 2: Effect of salicylic concentration and cultivation distances in absolute growth rate trait. (mg day⁻¹).

Salicylic level (Mg L ⁻¹)	Seeding spaces (cm)		
	10	20	Mean
0	0.04189 b	0.04947 e	0.04568 c
50	0.05521 d	0.06957 b	0.06239 b
100	0.06444 c	0.08236 a	0.07340 a
Mean	0.05384 b	0.06714 a	

3- number of grains (grain panicle⁻¹):

The results of statistical analysis of the average number of grains for oat panicle (Table 3) indicate a significant superiority in the addition of salicylic acid at a concentration of 100 mg L⁻¹ over the rest of the used concentrations, an increase of 29.45%, with the highest average concentration of 54.10 grain panicle⁻¹ above the average of the control treatment (without spraying) of 41.79 panicle⁻¹. the role of salicylic acid in growth is highlighted by improving the processes of division and elongation and increasing the rates of carbon representation, and the improvement of the characteristics of the growth of physiologically increased the ability of the plant to reduce the competition between the vegetative and flowering part in obtaining nutrients during the period of the emergence of panicles and flowers and the period of grain filling (Assuero and Tognetti, 2010).

Results of the same table indicate that there is a significant difference between the planting distances between the lines, with the highest average score of 20 cm with an average of 52.67 grain panicle⁻¹ at a distance of 10 cm, which recorded an average of 44.79 grain panicle⁻¹ with a difference of 17.59%. This may be due to the receipt of a sufficient amount of light with the availability of the basic nutrients available to the oat plants by finding the appropriate space for

germination and growth, especially in the stages of differentiation of the developing apex and growth of the spike, it contributed to an increase in the number of grains (Al-Hasnaoui, 2016). Table (3) shows that there is a significant difference in the Interaction between the growth regulator concentration factors and the cultivation distances, where the Interaction of 100 mg L⁻¹ and the distance between the planting lines is 20 cm higher than the average grade of 57.850 grain panicle⁻¹ than the lowest average recorded by the interference in the control treatment (without spraying). For salicylic the distance of 10 cm between the planting lines, was 36.383% for the grade, with a difference of 59.002%.

Table 3: Effect of salicylic concentration and planting distances in the number of grains in the panicle. (grain panicle⁻¹).

Salicylic level (Mg L ⁻¹)	Seeding spaces (cm)		
	10	20	Mean
0	36.383 e	47.203 d	41.79 c
50	47.650 d	52.953 b	50.30 b
100	50.347 c	57.850 a	54.10 a
Mean	44.79 b	52.67 a	

4- The Weight of a thousand grains (gm).

The results of Table (4) show a significant difference between the salicylic spray concentration levels applied, with the highest average weight score of 1000 grain for the concentration 100 and 75 mg L⁻¹ being 30.410 and 29.050 g respectively, a difference of 18.81% compared with the lowest average recorded by the comparison treatment (25.595) g. This may be due to the role of salicylic acid in increasing the levels of plant metabolism and its effect on the processes of division and vegetative and radical construction which increase the accumulation of organic substances such as proteins, carbohydrates, etc., and the regulation of the distribution of dry matter between the vegetative, fruiting and grain parts (Meena et al., 2013).

The results of the same table indicate that there is a significant difference between the planting distances between the lines, as the highest average score was 20 cm with an average distance of 30.280 g over the distance of 10 cm, which recorded an average of 26.421 g with a difference of 14.6%. The reason for this may be due to the receipt of a sufficient amount of light with the availability of basic nutrients that were available to oat plants by finding the appropriate space for germination and growth, especially in the stages of the development of the summit and the growth of the spaghetti contributed to an increase in the number of seeds and the accumulation of dry matter in them. These results are consistent with Ali et al. (2010).

Table (4) shows that there is a significant difference in the Interaction between the growth regulator concentration factors and the cultivation distances, where the Interaction was 100 mg L⁻¹ and the distance between the planting lines 20 cm higher average grade of 32.853 g than the lowest average recorded by the comparison treatment Interaction (control). for salicylic and the distance of 10 cm between planting lines with an average of 24.520 with a 33.98% difference.

Table 4: Effect of salicylic concentration and planting distances in the weight of 1000 grain. (g).

Salicylic level (Mg L ⁻¹)	Seeding spaces (cm)		
	10	20	Mean
0	24.520 e	26.670 d	25.595 b
50	26.787 d	31.317 b	29.050 a
100	27.957 c	32.853 a	30.410 a
Mean	26.421 b	30.280 a	

CONCLUSIONS

The results of the experiment showed a clear positive effect of using the salicylic growth regulator at a concentration of 100 mg L⁻¹, as this concentration outperformed the other levels in improving the characteristics of oat plants, including the duration of dry matter production, the absolute growth rate, and the number of grains in the panicle. The weight of a thousand grains. The results also showed that a distance between planting lines of 20 cm was more effective than a distance of 10 cm, as it achieved noticeable improvements in all the traits studied.

Moreover, the interaction between the concentration of 100 mg L⁻¹ and the distance of 20 cm showed highly significant differences compared to the other concentration levels and distances, indicating that combining these two factors can significantly enhance the productivity of oat plants. Therefore, it is recommended to use a concentration of 100 mg L⁻¹ of salicylic acid with a distance between planting lines of 20 cm to achieve the best results in oat cultivation.

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