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Effect Agricultural Sulfur and Nitrogen on Growth and Yield Stressed Oat *(*Avena Sativa L.)

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Abstract

A field experiment was carried out in in 2018-2019 at the Experimental Station of the University of Muthanna, Al- Governorate / Al-Warka to study the effect of different treatments of nitrogen and sulfur on the growth and grain yield of the oatThe experiment was carried out according to the system of split –plot design in the Randomized Complete Block RCBD with three replications. Four nitrogen fertilizer application gradients were (0 , 60 , 120 ,180) kg $N.h^{-1}$ main plot, while three agriculture sulfur treatments (0,1000,2000) kg $S.h^{-1}$, were set in secondary plot. The most important results, including the following:The results showed a significant superiority in the level of fertilizer 180 kg N h^{-1}on the yield traits height of plant 100.98 cm, 49.55 grains. $Panicle^{-1}$, Number of panicles m^{-2} 424.7 panicle m^{-2} ,the ratio of stem to leaves 6.713, The green fodder yield 25.08 $tons.h^{-1}$ and yield 3.667 $tons.h^{-1}$, while The results showed a significant superiority in the level of fertilizer 2000 kg $S.h^{-1}$ in , Number of panicles m^{-2} 386.5 panicle m^{-2} and the green fodder yield 22.17 $tons.h^{-1}$, The results of interactions between fertilizer levels nitrogen andagriculturesulfur significant in height of plant 107.06 cm and the green fodder yield 25.78 $tons.h^{-1}$.

Introduction

Avena sativa L. is one of the most important forage crops in the development of animal husbandry. And it was annual herbaceous plant with strong adaptability, wide distribution, high yield, good quality and easy cultivation. make hay. It was an important forage fodder for winter and spring supplementation, which plays a very important role in stabilizing livestock production (Zhu, 2010). Recent decades have seen increased interest in non-bread cereals, particularly oats and barley. Studies have been conducted on their physicochemical and health-promoting properties, owing to which they can be used for a variety of purposes, in dietetics, medicine or processing (Zarzecka et al. 2015). Oats and oat products exert beneficial effects on human health because they contain protein of the highest biological quality; they are rich in essential unsaturated fatty acids and vitamins (E and B1, B2 and B6). They are also a valuable source of fibre, which is essential in the human diet. oat grain contains the highest amount of ash, composed of macro- and microelements.Nitrogen was a key limiting factor for the physiological metabolism and growth of crops4. Nitrogen fertilizer plays an extremely important role in improving the yield per unit area of food crops. And nitrogen fertilizer application amount accounts for about 2/3 of total fertilizer application amount, but utilization rate is less than 40%. (Liu, , 2014),

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Nitrogen fertilizer is an important factor and which can affect the growth and development of *Avena sativa* L. The lach of nitrogen fertilizer application can cause leaves to lost chlorophyll, affecting photosynthesis and growth was restrained. Excessive nitrogen application will lead the stalk spindling and fall easily (Zhang, H. Y , 2009).And studies have shown that the height of Avena sativa L. showed first increased and then decreased with the increase of the amount of nitrogen fertilizer application. Soils of arid and semi-arid regions, such as Iraqi soils, have a high content of calcium carbonate and have a high pH that tends to be alkaline and thus the readiness of the nutrients, especially the micronutrients, is reduced. Therefore, it is imperative to follow methods that will increase the readiness of these important elements in Increase the physiological processes of the plant and thus increase the growth of the yield, and the fact that the plant cannot complete its life cycle without it, and among these methods is the addition of agricultural sulfur to the soil, which is involved in many reactions that take place in the soil, due to the multiplicity of chemical, organic and mineral sulfur forms and the multiplicity of types of life Microstructures that contribute to its transformations in the soil, which are primarily responsible for the transformation of organic sulfur forms into a mineral ready for plants (Josseph et al., 2013 and He et al., 2010).

Materials and Methods

A field experiment was carried out in in 2018-2019 at the Experimental Station of the University ofMuthanna, Al- Governorate / Al-Warka to study the effect of different treatments of nitrogen and sulfur on the growth and grain yield of the oat in soil some of its chemical and physical properties are shown in Table (1) Some chemical and physical properties of field soil.

Table (1) Some chemical and physical properties of field soil

Electrical conductivity EC	pH	Available nitrogen	Available phosphorus	Available potassium	Soil separators(%)		
					Sand	silt	Clay
6.1 dsm-1	6.5	12.7 mg kg-1 soil	25.7 mg kg-1 soil	119.8 mg kg-1 soil	250	600	150

Experiment design. *Avena sativa* L. was planted on April 25, 2018, and depth 3 cm. The experiment was carried out according to the split –plot design using the RCBD with three replications. Four nitrogen fertilizer application gradients were (0 ,60 , 120 ,180)N kg/h main plot, while three agriculture sulfurtreatments(0,1000,2000) kg/h,were set in secondary plot. The experimental land was prepared by plowing two perpendicular to the plow by the tipping plow, after performing the process of plowing it, then the soil was graded with disc harrows and then it was leveled by the leveling machine, then the land was divided according to the design used into plots with an area of (2 * 2 m) As the number of experimental units reached 36 experimental units, and the planting was carried out on lines and distance between lines 20 cm and the secondary plots were separated from each other (0.5 m).

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RESULTS AND DISCUSSION

height of plant (cm):

The height of oat showed first increased with rising of nitrogen fertilizer ,Plant height varied between 88.49 cm and 107.06 cm (Table 2). The average plant height was 90.26 cm for the control treatment. It was increased to 100.98 cm at N 180 kg $N.h^{-1}$(Table 2). Previous researchers were reported increasing in plant height by increased N fertilization,The reason for the increase in plant height may be attributed to the effect of nitrogen in increasing the growth and division of cells and elongating phalanges, due to its effect on the formation of the amino acids necessary for the elongation of plant cells, including Tryptophan, which forms the basis for building auxin that has an effect on cell division, which led to an increase in plant height. This result is in agreement with the findings of Shah et al., 2002; Rocquigny et al., 2004.generally no statistically confirmed differences were found in the effect on the height of plant between agricultural sulfur applications.The results of interactions between the treatments showed significant superiority, and the 180 kg $N.h^{-1}$x 2000 S $kg.h^{-1}$treatment gave the highest height of oats, 107.06 cm (Table 2).

Table (2) shows the effect of agricultural sulfur and nitrogen on the height of plant (cm)

Nitrogen treatments (kg/h)	Sulfur treatments (kg/h)			Average
	0	1000	2000	
0	89.36	88.49	92.92	90.26
60	97.64	83.5	91.85	91
120	97.86	101.15	89.97	96.33
180	94.73	101.15	107.06	100.98
Mean	94.9	93.57	95.45	
L.S.D0.05	N	S	N*S	
	2.247	ns	3.892	

Number of panicles m^{-2}

The results table (3) showed a significant increase in the number of panicles m^{-2} with an increase in the levels of added nitrogen, as the level recorded 180 kg N. h^{-1} was significantly superior to the rest of the other levels by giving the highest average for this trait, which reached 424.7 panicles m^{-2}, while the control treatment gave the lowest average for the number of panicles m^{-2}, which amounted to 350.1 panicles m^{-2}, and the reason for this may be attributed to the role of nitrogen in improving the vegetative growth of the plant in general at different crop growth stages, especially the number of shoots per unit area, and this result agreed with results of Iqbal*et al.* (2009) on the yield of oats.Depending on the fertilizer variant, the differences in number of panicles m^{-2} between the fertilized and control treatments varied on average from 386.5 panicles m^{-2} in 2000 kg $S.h^{-1}$ to 372.4 panicles m^{-2} in control. A beneficial effect of sulfur on the yield of cereals has been shown by numerous researchers (Barczak 2010).

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Table (3) shows the effect of agricultural sulfur and nitrogen on the number ofpanicles m^{-2}

Nitrogen treatments (kg/h)	Sulfur treatments (kg/h)			Average
	0	1000	2000	
0	336.7	352.8	360.8	350.1
60	354.8	357.7	352.5	355
120	388.8	379.3	392.9	387
180	409.3	425	439.8	424.7
avrage	372.4	378.7	386.5	
	N	S	N*S	
L.S.D0.05	13.18	11.42	ns	

Number of grains. Panicle^{-1}

The results showed in Table (4) that the level of 180 kg N.h^{-1}exceeded by giving the highest average grains. Panicle^{-1}, which was 49.55 grains. Panicle^{-1}, while the control treatment gave the lowest average for this trait, which was 44.89 grains. Panicle^{-1}, the increase in nitrogen levels may be attributed to the fact that the availability of nitrogen in the stages of crop growth and development contributed to raising the efficiency of the photosynthesis process and increasing its outputs, as well as increasing the chlorophyll content and creating an appropriate opportunity to reduce the state of abortion in florets By reducing the state of competition between them for the foodstuffs produced as a result of the small number grains. Panicle^{-1}, then an increase in the number of grains.Panicle^{-1}, and this result is similar to the findings of Yunus and Hassan (2012) on oats.

Table (4) shows the effect of agricultural sulfur and nitrogen on the number of grains. Panicle^{-1}

Nitrogen treatments (kg/h)	Sulfur treatments (kg/h)			Average
	0	1000	2000	
0	46.07	43.71	44.89	44.89
60	47.3	47.68	45.92	46.97
120	48.56	48.42	46.83	47.94
180	48.5	49.88	50.26	49.55
avrage	47.61	47.43	46.98	
	N	S	N*S	
L.S.D0.05	1.985	ns	Ns	

The ratio of stem to leaves:

The results showed in Table (5) that the level of 180 kg N.h-1 exceeded by giving the highest average the ratio of stem to leaves , which was 6.713, while the control treatment gave the lowest average for this trait, which was 6.309, the increase in nitrogen levels may be attributed to the fact that the availability of nitrogen in the stages of crop growth and development contributed to raising the efficiency of the photosynthesis process and increasing its outputs.

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Table (5) shows the effect of agricultural sulfur and nitrogen on the

Nitrogen treatments (kg/h)	Sulfur treatments (kg/h)			avrage
	0	1000	2000	
0	6.287	6.221	6.419	6.309
60	6.836	6.87	6.687	6.797
120	6.428	6.648	6.77	6.615
180	6.541	6.869	6.729	6.713
avrage	6.523	6.652	6.651	
	N	S	N*S	
L.S.D0.05	0.199	ns	ns	

The green fodder yield

The results in Table (6) indicated the significant effect of nitrogen fertilizer levels on the yield of green fodder, as the level of 180 kg kg N.h^{-1}exceeded significantly over the remaining levels by giving the highest green fodder yield of 25.08 tons. h-1, while the comparison treatment gave the lowest. The total amounted to 15.86 tons. h^{-1}, and the reason for this may be attributed to the increase in the efficiency of the photosynthesis process, which means an increase in the production and accumulation of dry matter, which caused an increase in the yield of green fodder. This result is in agreement with the findings of Assaeed (1994) on the yield of oats who indicated an increase in the yield of green fodder by increasing nitrogen levels, Depending on the fertilizer variant, the differences in tons. h^{-1}between the fertilized and control treatments varied on average from 22.17 tons. h^{-1} in level 2000 kg.h^{-1} to 19.17 tons. h^{-1}in control. A beneficial effect of sulfur on the yield of cereals has been shown by numerous researchers (Barczak 2010). The interference between the treatments showed significant superiority, and the 180 kg N.h^{-1}x 2000 kg S.h^{-1} treatment gave the highest height of oats, 25.78 tons. h^{-1} (Table 6).

Table (6) shows the effect of agricultural sulfur and nitrogen on the green fodder yield tons. h^{-1}

itrogen treatments (kg/h)	Sulfur treatments (kg/h)			avrage
	0	1000	2000	
0	12.64	17.25	17.7	15.86
60	20.98	21.14	20.39	20.84
120	20.73	21.9	24.8	22.48
180	24.48	24.98	25.78	25.08
avrage	19.71	21.32	22.17	
	N	S	N*S	
L.S.D0.05	1.077	0.932	1.865	

yield

The results of Table (7) indicated the superiority of the level of 180 kg N.h^{-1}at other levels, by giving the highest average grain yield of 3,667 tons. h-1, while the comparison treatment gave the lowest average for this characteristic, as it reached

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3.117 tons. h^{-1}, and this result is in agreement with the findings of Yunus and Al-Hassan (2012) on the yield of oats .generally no statistically confirmed differences were found in the effect on the height of plant between agricultural sulfur applications and the interference between the treatments.

Table (7) shows the effect of agricultural sulfur and nitrogen on the yield kg/h

Nitrogen treatments (kg/h)	Sulfur treatments (kg/h)			avrage
	0	1000	2000	
0	2.763	3.06	3.529	3.117
60	3.136	3.337	3.258	3.243
120	3.353	3.42	3.529	3.434
180	3.511	3.679	3.811	3.667
avrage	3.191	3.374	3.532	
	N	S	N*S	
L.S.D0.05	0.428	ns	ns	

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