

Effect of Phosphate Fertilization and Kalotamik Acid Spray on some Characteristics of Growth and Yield of Oats (*Avena Sativa L.*)

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Abstract. The experiment was carried out in the Abu Al-Fadl Forest Nursery, the Plant Production Department, Al-Diwaniyah Agriculture Directorate (3 km north-east of Al-Diwaniyah city) during the winter season 2021-2022, to determine the effect of four levels of phosphate fertilizer (0, 30, 60 and 90 kg P ha⁻¹) and two concentrations of kalotamik acid spray (0 and 200 mg kalotamik L⁻¹), on the growth and yield of oats *Avena sativa L.* Shifa cultivar. The experiment was applied according to a Randomized Complete Block Design (RCBD) by a split plot, with three replicates. The levels of phosphate fertilizer were distributed in the main plots, while the concentrations of amino acids occupied the sub-plots. The results showed the following: the superiority of plants fertilized at the fertilizer level of 90 kg P ha⁻¹ significantly on the number of tillers, the number of dahlias, the weight of a thousand grains g, the biological yield and grain yield, were given 532 tillers m⁻², 468.58 dalia m⁻², 46.76 g, 56.39 mcg ha⁻¹, and 8.92 mcg ha⁻¹, respectively, the results also showed that the plants treated with kalotamik acid (concentration 200 mg L⁻¹) were significantly superior to the number of tillers and the number of dahlias, it gave 493.42 tillers m⁻² and 414.67 Dalia m⁻². The interaction between the two experimental factors (fertilization at a level of 90 kg P ha⁻¹ and spraying with kalotamik acid at a concentration of 200 mg L⁻¹) had a significant effect on the biological yield and grain yield.

Keywords. Phosphate fertilization, Kalotamik acid, Growth, Yield, Oats *Avena sativa L.*

1. Introduction

Cereal crops are the first field crops that are more productive and consumed compared to the crops planted by humans. Oats (*Avena sativa L.*) is an important crop, as it is a herbaceous winter annual plant belonging to the Poaceae family, the cultivated area of it is estimated globally at 9.30 million hectares, producing about 22.48 million tons[1], it is ranked sixth after wheat, rice, yellow corn, barley and sorghum, grown in many countries of the world due to its nutritional importance, characterized by its high content of unsaturated fats, nutrients, calcium, sodium, magnesium, iron and phosphorous, in addition to vitamin B and antioxidants, which can help lower the risk of heart attacks and strokes. Its ranking in the list of the most important cereal crops varies according to its economic importance from one country to another. In Iraq, the crop did not receive its share of attention, the wild species of it



grows as bushes in wheat and barley fields, and it is called locally (Al-Dosser). Currently, it is cultivated in many regions of the world, as it is successfully cultivated in various types of soils, it can be grown in fertile, well-drained clay soils, it was more tolerant of soil acidity than wheat and barley [2].

The use of amino acids is one of the important basic requirements that help in improving the quality and raising the production rate per unit area, amino acids have several physiological effects in plants and are of great importance in stimulating growth and maintaining cell pH, it is an essential source of nitrogen when added, in building proteins and processing energy to encourage vegetative and root growth of plants, which reflects positively on the outcome and its components, amino acids may reduce fertilizer use and improve plant growth, amino acids also have an important role by acting as biostimulants, by increasing absorption and impro nutrients[3], According to [4], amino acids promote root growth and activate the growth of the vegetative part of the plant, the absorption of nutrients through the roots depends on the amount of aspartic in the plant, experiments have shown that amino acids increase and improve plant respiration, photosynthesis and water absorption, as well as promoting plant growth and yield[5].

2. Materials and Methods

2.1. Experience Site

The field experiment was carried out in the Abu Al-Fadl forest nursery, Diwaniyah Agriculture Directorate, Al-Qadisiyah Governorate located, between longitude and latitude 44.924722 and 31.989167 during the winter agricultural season 2021-2022. Laboratory analyzes were carried out in the Soil Fertility Laboratory - Al-Diwaniyah Agriculture Directorate, to know some physical and chemical properties of soil, as in the table below:-

Table 1. Some physical and chemical properties of field soil before planting.

	Physical traits			Chemical traits				
Trait	Clay	Silt	Sand	K	P	N	ECe	Ph
Value	45	20	35	132 ppm	12 ppm	15 ppm	2	7.3

The analyzes were carried out in the soil and water laboratory in the Diwaniyah Agriculture Directorate

2.2. Agricultural Operations

The land of the experiment was plowed twice perpendicular to the plow with the inverted plow, and the radovitor was smoothed, after leveling, it was divided into plots according to the arrangement of the split plots by designing randomized complete sectors and with three replica-tions. The main plots included four levels of phosphate fertilization (0, 30, 60 and 90) kg P ha⁻¹. Its symbols were P0, P1, P2, P3, respectively, the sub plots contain two concentrations of kalotamik acid (spraying distilled water only) with a symbol A0 and (200 mg / liter) a symbol A1. The process of nitrogen fertilization 120 kg N ha⁻¹ was carried out in three equal batches of urea fertilizer (46% N)[6], also, potassium fertilizer was added in the form of potassium sulfate (42% K) in one batch when planting, (with an amount of 40 kg K ha⁻¹)[7], phosphate fertilizer levels were added all at once during cultivation in the form of triple superphosphate (P₂O₅). Irrigation and weeding operations were also carried out as needed. The stages of adding paper feeding factors according to the scale of [8], were determined by the second factor in three batches (the first in the branching stage, the second in the elongation stage and the third in the lining stage), the traits were measured as follows:

- The tillers number m⁻² was calculated from the area of the harvested square meter.
- The dahlias number was calculated from the harvested square meter area.
- Estimate the 1000 grains weight by a random way from the grain yield and using a sensitive scale.

- The grain yield was estimated from the harvest of a square meter area and converted on the basis of Mg ha^{-1} .
- The biological yield was estimated from the same area from which the grain yield was calculated in each experimental unit. The whole plants (grains + straw) were weighed and then converted to Mg ha^{-1} .

3. Results and Discussion

Table (2) showed that the fertilizer level P3, which gave the highest average number of tillers, reached $532.08 \text{ tillers m}^{-2}$, whereas, the level P1 gave the lowest average for this trait, which amounted to $439.75 \text{ tillers m}^{-2}$. The difference in the increase in the average number of strands came as a result of the importance of phosphate fertilizer in the formation of lateral roots and root hairs, which contributed to increasing the absorption of water and nutrients from the soil, leads to strengthening the legs and increasing the number of tillers, because it is a main source for cell division and increased plant growth, and it is concentrated in the most effective areas [9].

The results of the same table also showed that the concentration of 12 gave the highest average number of tillers per square meter, which amounted to $527.75 \text{ tillers m}^{-2}$, whereas, treatment A0 gave the lowest mean for this trait, which amounted to $493.42 \text{ tillers m}^{-2}$, the reason for this is that the use of aspartic acid can affect the physiological activities in plant growth and yield[10], thus, the amino acids promoted the development of the root system and stimulated the growth of the vegetative part of the plant [4].

The results of the same table showed a significant increase in the number of dahlias m^{-2} when adding levels of phosphate fertilizer, the level of P3 exceeded, gave the highest average for this trait amounted to $468.58 \text{ dahlias m}^{-2}$, while the P1 level gave the lowest average for the trait, which was dahlias m^{-2} . The reason for this is due to the increase in the number of shafts, which was reflected in the increase in the number of spindles per unit area.

Table (2) showed a significant increase when adding phosphate fertilizer in the weight of 1000 grains, which gave the treatment P3 the highest average amounted to 46.76 gm , while the fertilizer level P1 gave the lowest average amounted to 35.78 gm , the reason for the increase in the weight of 1000 grains can be attributed to the availability of phosphorous, which increased by increasing the phosphate fertilizer, which led to the availability of the phosphorous element in a more ready way for the plant, which encouraged important metabolic processes in the formation of starches and proteins and their storage and assembly in grains, while the statistical analysis showed that there was no significant effect of the effect of kalotamik acid on the trait of weight of a thousand grains.

The results of the same table showed that the P3 level was superior, and the highest mean of grain yield was recorded, which was 8.92 Mg ha^{-1} , as measured by the comparison treatment P0, which gave the lowest mean for the trait, it was 5.21 Mg ha^{-1} . The reason for this is due to the su-periority of this treatment in the number of dahlias and the number of grains per dahlia.

Table 2 showed the superiority of the level of P3 fertilization, as it gave the highest mean of the bio-crop characteristic of 56.39 MG ha^{-1} , while the comparison treatment P0 gave the lowest mean for this trait which was 33.86 Mg ha^{-1} . The reason for this increase can be attributed to the superiority of the P3 level in most of the growth characteristics and yield represented by the number of tillers and grain yield, while the acid did not have any significant effect on the character of grain yield and biological yield.

Table 2. Shows the effect of phosphorous levels and kalotamik amino acid concentrations on the tillers number (tillers m⁻²), the dahlias number (dahlias m⁻²), 1000 grains weight (gm), the grain yield (mcg ha⁻¹) and the biological yield (mcg h⁻¹).

Traits/ Treatments	Tillers number (tillers m ⁻²)	The dahlias number (dahlias m ⁻²)	1000 grains weight (gm)	The grain yield (mcg ha ⁻¹)	The biological yield (mcg h ⁻¹).
Phosphorous levels					
P0	481.75	434.92	38.49	5.21	33.86
P1	439.75	398.33	35.78	5.58	39.63
P2	529.83	467.08	44.95	7.86	51.03
P3	532.08	468.58	46.76	8.92	56.39
LSD _{0.05}	17.57*	19.18*	4.97*	0.74*	7.75*
kalotamik amino acid concentrations					
A0	443.92	414.42	37.39	6.64	43.67
A1	493.42	414.67	40.09	6.68	45.84
LSD _{0.05}	18.41*	16.39*	N.S	N.S	N.S

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