Effect of Spraying Some Bio-and Nano-Stimulants Fortified with Potassium on the Growth and Yield of Rice

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Effect of Spraying Some Bio-and Nano-Stimulants Fortified with Potassium on the Growth and Yield of Rice

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Abstract. The aim of evaluating the response of rice plant (Anber 33 cultivar) to foliar spraying with single bio- and nano-stimulants with potassium-fortified, A field study was conducted in Al-Tale'a district (41 - Al-Hussainiya) / Babylon province / Iraq. for the period from 15/6/2021 to 23/11/2021.The experiment was implemented according to the Randomized Complete Blocks Design (RCBD), with three replications (48 experimental units) and the experiment included 16 treatments that were randomly distributed to each replicate according to a simple one-way experiment where (7) bioandnano- stimulants were sprayed, represented by Atonikt , Fertigrain, Siaption, Cimfamin BK, Taravertavant, Nano-Optimus plus, and bread yeast (*Saccharmyces cerevisiae*) individually and fortified with potassium (Tarafol K_2O 52%), in addition to the control treatment, spraying with water only, with two sprays for each treatment between one spray and another (14) days. Duncan's test results showed that foliar spraying with Atonikbiostimulator supplemented with potassium (At+K) scored the highest averages of chlorophyll index (38.87) SPAD, plant height (119.7 cm) and grain yield (3.29) Meg ha^{-1}.Also, foliar spraying with the biostimulantTaravertavant and potassium (Tar + K) achieved the highest significant averages for most of the important traits of the plant, including the biological yield (14.97) Meg ha^{-1}, grain yield (4.31) Meg ha^{-1}, and the weight of 1000 grains (21.23) g. compared with the control treatment, the chlorophyll index was (35.50) SPAD, the plant height was (100.7) cm, the biological yield was (11.13) Meg ha^{-1}, and the grain yield was (3.11) Meg ha^{-1}, the weight of 1000 grains (18.67) g respectively, and the highest agronomic efficiency was achieved when the treatment The dual spraying of potassium-fortified Nano-Optimus plus (Nop+K) was ingested (293.9 kg kg^{-1}).

Keywords. Rice, Nano-biostimulants, Amino acids, Potassium, Atonik, Bread yeast.

1. Introduction

Biostimulators are any organic matter such as amino acids fortified with Macro and Micro elements, plant extracts, seaweed and hormones or micro-organisms used with plants for the purpose of improving nutrition efficiency, crop quality and tolerance to abiotic stresses are used as a spray on plants or added to the soil regardless of the nutrients they contain[1].Potassium is also one of the elements that play important roles in plants, including in regulating the osmotic effort of plant cells , It enters the process of opening and closing stomata and activates more than 80 enzymes responsible for the representation of nitrogen, energy and respiration [2,3]. The nano-stimulators that have been developed are nutrient carriers with nanoscale dimensions ranging from 1–100 nm, Nanoparticles are characterized by a high surface area and a high ability to retain nutrients with a high stabilization

liberation that facilitates the absorption of nutrients [4].Nanomaterials stimulate many vital aspects of plants and both the leaf surface and plant root are gateways for key plant nutrients that are easily penetrated by nanomaterials [5].In plants, amino acids are combined with each other to form proteins and various peptide compounds or they are freely present. There (20) amino acids are freely present in the plant tissue. The amino acids work to increase plant growth, improve the quality of the yield and reduce the fertilizers used [6]. and using it as a spray on the leaves provides the plant with a speed of growth and the building of amino acids, especially in critical times for the plant [7].Bread yeast is considered one of the environmentally friendly, very effective and cheap sources of biostimulation [8], and it is a living organism that is characterized by containing many nutrients, including nitrogen, phosphorous, potassium, iron, zinc, sodium, silicon, as well as containing growth regulators such as auxins and acids. The amino acids and vitamins such as B1 and B6 activate the division process of plant cells and improve the quality and quality of crops [9]. Rice (*Oryza sativa* L) is grown in 114 countries around the world, and it is one of the most important grain crops in the world and half of the world's population depends on rice [10].Asia and the Pacific regions produce and consume more than 90% of the total rice production in the world [11].As for locally, Iraq's production of a crop in Iraq for the summer season of 2020 was estimated to be about 464.2 thousand tons, and the percentage decrease was estimated at 19.2% compared to the year 2019 [12].
In order to achieve the highest qualitative and quantitative yield of rice, the current study aimed to Knowing the effect of spraying bio-stimulants (traditional and nano amino acids, Atonik and Bread yeast) on some growth and yield parameters and the effect of spraying single types of biostimulants supplemented with potassium on some growth parameters and grain yield of rice crop Anber 33 cultivar grown in the Euphrates river soil.

2. Materials and Methods

2.1. Experiment Site

A field study was conducted in 41 - Al-Hussainiya, Al-Tali'ah District , Babylon provainc / Iraq, within latitude (N-3560050) and longitude (E-481907), for the period from 15/6/2021 to 23/11/2021, which is the period required for the growth of rice crop.

2.2. The Experiment Design

The experiment was implemented according to the Randomized Complete Blocks Design (RCBD), the experiment included 16 treatments that were randomly distributed according to a simple one-way experiment with three replications. Where (7) bio- and nano-stimulators, represented by Atonikt, Fertigrain, Siaption, Cimfamin BK, Taravertavant, nano-Optimus plus and bread yeast (*Saccharmycescerevisiae*), were sprayed individually and supplemented with potassium (Tarafol K_2O 52%) at a rate of two sprays between one spray and another 14 days, at a rate of 400 liters ha^{-1} of the spray mixture. The spraying was conducted in the early morning, and the averages were tested according to the Duncan test [13].

Table 1. Shows the components of bio-and nano-stimulators used in the experiment.

stimulators name	type	composition
Atonik	liquid	Sodium para – nitrophenolate 0.3%,Sodium 5 – nitrogualacolate 0.1% Sodium ortho – nitrophenolate 0.3%
Cifamin BK	liquid	organic nitrogen 8%,organic carbon 20% 0.01% zinc + 0.1% manganese + 0.01% boron
Siapton	liquid	Amino Acids (Proline-Hydroxy-Classine) % + Free Amino Acids %
Taravartavant	liquid	Amino acids + organic matter + trace elements
Fertigrain Foliar	liquid	free amino acids is 8%, 5% N, 0.75% Zn, 0.1% B, 0.1% Fe, 0.1% Cu, 0.02% Mo and 0.01% Co)
Nono-Optimus plus	Nano-liquid	50% organic matter, free amino acids 29%,organic carbon 20% Nitrogen 2%
Saccharmycescerevisiae	liquid	dry yeast was dissolved in water and then added with sugar at a ratio of 1:1.
Tarafol K_2O 52%	powder	Total Nitrogen 3%,urea nitrogen 3%and Potassium oxide K_2O 52%

2.3. Experiment Field Preparations

The experiment field was assigned and the process of perpendicular tillage, smoothing, and leveling was conducted for it. The sample of field soil was taken at a depth of 20 cm from five sites represented by the four sides of the field and the middle to be a representative sample of the field soil, which is characterized as alluvial soil with a Silty Clay Loam texture and classified by Entisols according to the modern American classification (Muhaimeed et al., 2014). The laboratory analyzes of the soil sample were conducted and included each of the electrical conductivity (ECe) = 3.1 ds m^{-1}, soil pH = 7.6, available nitrogen = 15.68 mg N kg^{-1}soil, available phosphorous = 13.4 mg P kg^{-1}soil, and available potassium = 270 mg K kg^{-1}soil, The organic matter = 14.5 g kg^{-1}. The experimental field, with an area of 250 (m^2), was divided into three equal replicate, and each replicate was divided into 16 experimental units.The area of one plot was (3 x 1.5 = 4.5 m^2), in addition to opening the streams necessary to irrigate the plots (experimental units) and the drains needed to drain the excess water.

Table 2. Shows the spraying of individual bio- and nano-stimulants supplemented with potassium and their concentrations.

No.Tr	Treatments	Symbol	Concentration gm or ml L^{-1}	
T1	Control spray water only	Con	first spray	The second spray
T2	Spray Atonik	At	2.5	2.5
T3	Spray Siapton 10 L	Si	2.5	2.5
T4	Spray Cifamin BK	Ci	2.5	2.5
T5	Spray Taravertavant	Tar	2.5	2.5
T6	Spray Fertigrain	Fer	2.5	2.5
T7	Spray Nano-Optimus Plus	NOp	2.5	2.5
T8	Spray *Saccharomyces cerevisiae*	*Sce*	2.5	2.5
T9	Spray taraful K_2O 52%	K	2.5	2.5
T10	Spray Atinic +K	At+K	1.25+1.25	1.25+1.25
T11	Spray Siapton 10 L+K	Si+K	1.25+1.25	1.25+1.25
T12	Spray Cifamin BK+K	Ci+K	1.25+1.25	1.25+1.25
T13	Spray Taravertavant+K	Tar+K	1.25+1.25	1.25+1.25
T14	Spray Fertigrain+K	Fer+K	1.25+1.25	1.25+1.25
T15	Spray NanoOptimusPlus+K	NOp+K	1.25+1.25	1.25+1.25
T16	Spray *Saccharomyces cerevisiae*+K	Sce+K	1.25+1.25	1.25+1.25

2.4. Cultivation and Crop Service

Rice seeds (Anber 33 cultivar) certified by the Rice Research Station in Al-Mishkhab District, Najaf province, on 15/6/2020, were sown 120 $kg.ha^{-1}$ of seeds by scattering directly on the previously prepared soil and then covering it with soil to prevent its erosion with water irrigation and capture by birds.The soil was irrigated and the irrigation process continued (every 3 days) after which the irrigation water depth was maintained at about 10 cm to ensure the availability of the appropriate amount of water needed for plant growth up to full maturity stage of plants ,Irrigation water was cut off from the field 15 days before harvest, in addition to the continuous weeding of the weeds.

2.5. Fertilization

A Initial fertilization ,then fertilizing all soil treatments with Tron (20:20:20) NPK fertilizer at an average of 200 kg ha-1. B. Foliar fertilization (spray) with bio- and nano-stimulants: bio-simulators were sprayed with Atonik, Cifamin, Siapton, Taravertavant, Fertigrain Foliar, Saccharmycescerevisiae bread yeast, and potassium fertilizer(Taraful K2O 52%) and the Nano-Optimus plus simulators with concentrations of 2.5 ml.L-1 per spray, two sprays of each simulators before flowering stage and 50% flowering between sprays and another 14 days.The size of the nano-optimum plus particles was also detected by scanning electron microscope FE-SEM in the central laboratory of the Physics Department / University of Tehran to ascertain the size of the particles within the nanoscale (1-100) nanometers (Fig. 1).

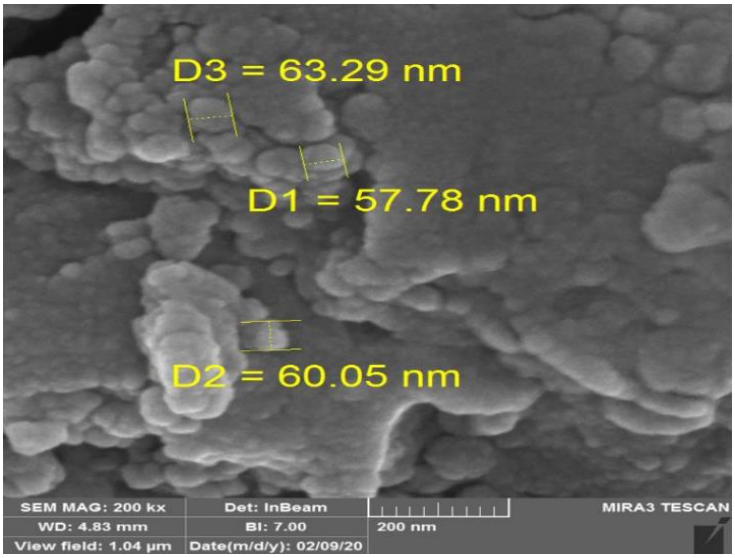

Figure 1. Pparticle sizes of Nano-Optimus Plus FE-SEM scanning electron microscope.

2.6. Harvest

The rice crop was harvested on 26/11/2021 when all plants reached the stage of full maturity and the moisture content of the grains ranged between 18-25% [14].

2.7. Studied Indicators

2.7.1. Chlorophyll in Leaves Index (SPAD)

The chlorophyll content of the leaves before the flowering stage of plants was measured by a portable SPAD-502 chlorophyll meter to get a quick estimation of the chlorophyll content of leaves in real time in the field [15].

2.7.2. Plant Height (cm)

Plant height was measured by measuring tape from the soil surface level to the top of the plant peak at flowering.[16]

2.7.3. Biological Yield (Meg ha^{-1})

The biological yield was estimated from the weight of the plants harvested within the specified square meter of each experimental unit after being air-dried for 10 days and converted to mg/ha, which includes the weight of the total dry matter above the soil surface after the sample was air-dried and its weight constant [17] .

2.7.4. Grain Yield (Meg ha^{-1})

The grains of the harvested plants were calculated (after being constant) within the specified square meter of each experimental unit and then mathematically converted to Meg ha^{-1} at a moisture content of 14%[17].

2.7.5. Harvest Index (%)

The harvest index of the rice yield was estimated by the equation:

$$\text{Harvest Index (\%)} = \frac{grain\ yield}{biological\ yield} \times 100 \quad [17].$$

2.7.6. 1000 Grain Weight (g)

The weight of 1000 grains for each treatment was estimated from 1,000 grains counting using a grain counting device in the Babylon Agriculture Directorate / Al-Muradia Research Station, and then

weighed with an electronic scale (measuring from 100 mg kg^{-1}) at a moisture content of 14%, which was measured by a multi-grain device.

2.7.7. Agronomic Efficiency(AE) kg Kg^{-1}

The Agronomic efficiency, or what is known as the fertilizer productivity, was calculated according to the following equation [18].

$$\text{A E (kg kg}^{-1}) = \frac{(grain\ yield\ in\ the\ fertilized\ treatment - Grain\ yield\ in\ the\ control\ treatment\ )}{Amount\ of\ stimulators\ sprayed\ per\ hectare}$$

2.7.8. Netting Percentage %

(100) g of grain were ground in the laboratory of Al- Hilla rice silo using a Japanese-made laboratory grinder, and the raw rice obtained from the milling process was put into a Japanese-made laboratory stone husk (Satake Husking rice machine) also to obtain the satake milling rice machine.), and the rice purification ratio was calculated according to the following equation:[19].

$$\text{Netting percentage} = \text{weight of bleached rice (g)} / \text{weight of grains (g)} \times 100$$

2.8. Statistical Analysis

The data of the experiment were analyzed statistically "according to the method of analysis of variance and according to the significant differences between the treatments in the RCBD design at the level of significance 0.05 using Duncan's least significant difference test [13].

3. Results

3.1. Plant Height (cm)

The trait of plant height increased to the level of significance when spraying bio-stimulants of all type, and the highest height was achieved at the treatments (At+K and Ci+K), which amounted to (119.7 and 118.7) cm Compared to (100.7) cm, these treatments did not show significant differences between them, while the treatments (Sce+K, Fer, Tar, Ci, Si, Sce and Tarf) achieved (112.3, 112, 112, 111.3, 110.7, 110.7 and 110) cm and were significantly excelled on the control treatment, without significant differences between them (Table .3).

Table 3. Effect of spraying nano and bio-stimulantsfortified with potassium on chlorophyll index SPAD, plant height cm, Biological yield (Meg ha^{-1}) and grain yield (Meg ha^{-1}).

No. Tr	Treatment s Symbol	Traits							
		plant height (cm)		chlorophyll index SPAD		biological yield Meg ha^{-1}		Grain yield Meg ha^{-1}	
1	Con	100.7	d	35.50	c	11.13	g	3.11	f
2	At	116.7	ab	36.27	bc	12.39	ef	4.09	b
3	Si	110.7	c	37.53	ab	11.93	efg	3.40	e
4	Ci	111.3	c	37.03	abc	11.66	fg	3.53	de
5	Tar	112.0	c	37.20	abc	13.17	cd	3.87	c
6	Fer	112.0	c	37.67	ab	12.10	ef	3.61	d
7	NOp	113.3	bc	38.27	a	11.89	efg	3.61	d
8	Sce	110.7	c	37.00	abc	11.19	g	3.51	de
9	K	110.0	c	37.07	abc	12.20	ef	3.61	d
10	At+K	119.7	a	38.87	a	13.79	bc	4.29	a
11	Si+k	113.3	bc	38.00	ab	14.02	b	4.12	b
12	Ci+k	118.7	a	37.57	ab	11.73	efg	3.98	bc
13	Tar+K	113.7	bc	37.67	ab	14.97	a	4.31	a
14	Fer+k	114.0	bc	38.30	a	12.48	de	4.02	bc
15	NOp+k	116.7	ab	38.47	a	12.13	ef	4.04	b
16	Sce+k	112.3	c	37.37	abc	12.43	ef	3.66	d

3.2. Chlorophyll Index (SPAD)

Table (3), we note that the praying with Nano-Optimus plus biostimulants and spraying treatments (At+K, Nop+K, and Fer+K) excelled on the control treatment, amounting to (38.27, 38.87, 38.47 and 38.30) SPAD respectively In compared to the control which amounted to (35.5) SPAD While these treatments did not show any significant difference between them, while the (Si+K, Tar+K, Fer, Ci+K and Si) treatments (38.00, 37.67, 37.67, 37.57 and 37.53) SPAD respectively compared to the control treatment and did not show any significant difference between them.

3.3. Biological Yield(Meg ha^{-1})

The bio- and nano-stimulants sprayins showed a significant effect on traits of Biological yield (Meg ha-1), where the treatment (Tar + K) showed a significant increase, which amounted to (14.97) Meg ha-1.Compared to the control treatment, which amounted to (11.13) Meg ha-1, followed by the treatment (Si + K) which amounted to (14.02) Meg ha-1 compared to the control treatment (spraying with water only) (Table. 3).

3.4. Grain Yield (Meg ha^{-1})

The results of Table (3) also indicated that the characteristic of the grain yield, increased significantly when the two treatments were sprayed with the biostimulants (Tar+K and At+K) which reached (4.31 and 4.29) Meg ha^{-1} compared to the control treatment which amounted to (3.11 Mg.ha^{-1})Then, the treatments (Sce+K, Tarf, Fer and NOp) were achieved, which amounted to (3.66, 3.61, 3.61 and 3.61) Meg ha^{-1} respectively, and were significantly excelled on the control treatment without significant differences between them.

3.5. Harvest Index %

Table (4) that the significant effect of spraying biostimulants on the harvest index of rice plants reached its maximum effect when spraying the biostimulants (Ci + K) and its value amounted to (33.87)% compared to the comparison of (27.93)%. Potassium was outperformed by the comparison treatment.

3.6. Weight 1000 Grains (g)

As it appears from Table (4) that spraying different biostimulants caused a clear difference in the weight of 1000 grain .The spraying of the bio-stimulant and potassium (Tar + K) achieved the highest significant value, reaching 21.23 (g).Compared the control treatment (water spray only), which reached (18.67 g), followed by the spraying treatment (Si + K), which reached (20.93) g, excelled on the control treatment.

3.7. Agronomic Efficiency kg kg^{-1}

also indicates that the highest field efficiency was when spraying the nano-potassium (NOp + k) and its value was (293.9) kg kg^{-1}, then followed by spraying (Si + K), which amounted to (251.7) kg kg$^{-1,}$ excelled on the control treatment (Table .4).

3.8. Netting percentage%

The Netting percentage was achieved when the spraying (NOp+K) treatment amounted to (74)%, followed by the (At+K) treatment, which amounted to (73.97%) and the spraying treatment (Ci+K) which achieved (73.27)%, with a significant difference between them. All of them significantly excelled on the control treatment, which amounted to (68.90)% (table .4).

Table 4. The effect of spraying bio- and nano-stimulants fortified with potassium on the harvest index%, the weight of 1000 grains, the field efficiency (kg kg^{-1}) and the Netting percentage %.

No.Tr	Treatments Symbol	traits							
		Harvest Index (%)		The 1000 grain weight (gm)		field efficiency kg kg^{-1}		Netting percentage %	
1	Con	27.93	c	18.67	e	0.0	f	68.90	g
2	At	31.51	abc	19.00	de	233.2	bc	72.47	de
3	Si	28.52	bc	20.60	abc	72.2	e	72.20	ef
4	Ci	30.55	abc	19.97	abcde	104.5	de	71.67	f
5	Tar	29.40	abc	19.79	abcde	209.9	c	72.00	ef
6	Fer	31.28	abc	19.87	abcde	124.9	d	71.90	ef
7	NOp	30.35	abc	19.67	bcde	125.0	d	71.87	ef
8	Sce	31.32	abc	20.00	abcde	99.5	de	72.00	ef
9	K	28.54	bc	19.33	cde	125.7	d	72.20	ef
10	At+K	31.10	abc	19.67	bcde	244.1	bc	73.97	b
11	Si+k	29.46	abc	20.93	ab	251.7	b	73.07	cd
12	Ci+k	33.87	a	20.33	abcd	217.1	bc	73.27	c
13	Tar+K	29.61	abc	21.23	a	217.1	bc	73.10	cd
14	Fer+k	32.16	abc	20.33	abcd	217.1	bc	74.60	a
15	NOp+k	33.36	ab	20.50	abc	293.9	a	72.00	ef
16	Sce+k	29.48	abc	20.67	abc	122.8	d	72.00	ef

4. Discussion

The increase in chlorophyll index SPAD in plant leaves and plant height is due to the effect of the growth regulator (Atonik) increased the chlorophyll index and plant height because Atonik is an aromatic nitrogen compound consisting of three groups of nitrophenol (Sodium 5-nitrogualacolate 0.1% and Sodium). para-nitrophenolate 0.3% and sodium ortho-nitrophenolate 0.2%).It is easily absorbed by plant tissues without causing damage or toxicity to the plant [20]. It has a good effect on the effectiveness of carbon metabolism, increasing the organic content and mineral compounds, increasing the accumulation of living mass, and increasing the efficiency of the photosynthesis process by increasing pigments, including chlorophyll, increasing the products of photosynthesis from proteins and carbohydrates, and maintaining the integrity of the cell and plasma walls of plant cells. In addition to its role in increasing endogenous oxygen, increases cell wall expansion and thus stem elongation [21,22]. this result agrees with what was stated [23] when spraying atonic on two cultivars of hybrid rice and that the foliar spraying of the biostimulantTaravertavant (Tar) led to an increase in the biological yield, grain yield, and the weight of 1000 grams and then increasing the biological yield [23]. Also, the important role that iron and zinc play in increasing the biological activities in the plant that lead to the biological yield [25]. It is consistent with what was stated [26] when spraying zinc and nitrogen on rice plants.It may be due to the effect of nitrogen contained within the components of stimulant, which is one of the most important elements in the growth of different crops, including grain crops and their production.

There is an agreed fact that nitrogen occupies the forefront among the nutrients added to the soil. Plants need nitrogen in large quantities to build their tissues. It is included in the formation of biofilms and is necessary for the synthesis of amino acids, which are the basis for the formation of proteins and vitamins. It also enters the composition of many important compounds such as purine and pyrimidine bases, from which the bases of adenine, uracil, guanine, thymine, and cytosine are derived, which are included in the synthesis of nucleic acids [2]. It also contributes to the formation of Porphyrin rings, which are involved in the formation of chlorophyll and cytochromes essential for photosynthesis and respiration. As well as entering the formation of enzymatic chaperones or other nitrogen-containing compounds in plants such as vitamins and plant growth regulators, as well as in the formation of energy compounds, especially ATP [27].

It enables the plant to consume carbohydrate compounds, so it becomes a homogeneous protoplasm and increases the volume of vegetative growth, as it regulates the work of cytokinins and as a result,

the number of meristematic cell divisions increases, which positively affects the increase in the volume of vegetative growth [28]. It agrees with [29] when spraying Nitrogen on the rice plant. It may be due to the effect of the amino acids present in the stimulate formula, which affects the grain yield and the weight of 1000 grains because it facilitates the absorption and use of nutrients in the vegetative growth stage, which increases the concentration of chlorophyll and photosynthesis as high as possible.This leads to an increase in the dry matter and also works to stimulate the activity of the enzymes responsible for the synthesis of carbohydrates, protein, and dry matter, which positively affects the grain yield and grain weight [30],and that the foliar spraying of amino acids during the vegetative growth stage leads to an increase in the vegetative and root growth due to their role as vital stimuli that stimulate the growth of roots and leaves and affect the vital processes [1].It agrees with what was found by [31] when spraying amino acids and potassium on rice plants. The foliar spraying of the stimuli led to a significant increase in the harvest index %, due to the fact that the biostimulants are positive growth regulators or carbon metabolism enhancers, which when applied in small quantities enhance the growth and productivity of plants, which affects the quantity and quality of crops [32]. The addition of stimulate that contain humic substances in their composition increases the ability to feed efficiency and improve the quality of crops [33].

The highest Agronomic efficiency was recorded when spraying with Nano-Optiums plus (Nop) and potassium, because spraying the nano-material has many side effects on the quality of crop nutrition and reducing plant stress and the lack of added quantities and costs due to the rapid absorption, large surface area, and transport, and making crops more resistant to diseases and drought and less hazardous to the environment [34]. As for the percentage of Netting in rice, it means the percentage of whiteness rice produced by Milling a known weight of the grains (husk) and that the amount of extracted percentages varies depending on many physical factors that are considered related to the nature of the grains, including the percentage of the outer casings (husk), which ranges between 18 - 22% of the weight of the grains and the degree of whiteness of up to 34%, and it has a significant effect on the percentage of extraction and that is through the amount of rice bran removed (husk), which reaches 8% of the weight of the grains, and in general, the percentage of netting, the percentage of netting grains of factory rice ranges between 68-58%, depending on the previous factors and that the increase in the percentage of netting when spraying the nano-stimulator Nono-Optiums plus (NOp) and potassium is due to the increase in vegetative growth traits that are positively reflected on improving vital activities and increasing enzymatic activities leading to stimulating increased production of dry matter and encouraging the absorption of nutrients from the leaves [35,36].

Potassium spray had an important and effective role in improving the products of the photosynthesis process and the speed of transporting the products to storage sites such as grains, because it speeds up the process of converting those products into starch and protein [37].Potassium is a catalyst for it, where there is a decrease in the ability of the leaves of plants to carry out the process of photosynthesis when there is a decrease in the level of potassium in the plant, due to its effect on the construction of the ATP compound, which is the main carrier of energy in the plant and a storehouse for it to represent CO_2 [38]. Potassium spray also plays an important role in increasing the grain yield due to the effects of potassium in controlling and growing the physiological functions of the plant and prolonging the period of filling the grains and increasing the yield components and biological yield that led to an increase in the grain yield. These results are consistent with what happened [3]when spraying Potassium on the rice plant. And with [39]when spraying potassium on rice plants.

Conclusion

From this study, we conclude the superior significant role of foliar spraying with the biostimulantAtonik and potassium (At+K) in recording the averages in each of the SPAD chlorophyll index, plant height and grain yield (Meg ha^{-1}), and treatment with the biostimulantTaravertavant and potassium (Tar+K) achieved the highest significant averages for the majority of The important characteristics of the plant, including the yield of biological and grain yield, (Meg ha^{-1})A weight of 1000 grains and the highest agronomic efficiency was achieved by the spraying of the potassium-supported nano-amio acids (NOp+K).

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