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OPTIMIZING NITROGEN FERTILIZERS BY USING SOME STIMULANTS FOR IMPROVING YIELD AND QUALITY OF *TRITICUM ASTIVUM* L. UNDER MINIA GOVERNORATE CONDITIONS

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ABSTRACT

A field experiment was conducted during two successive winter growing seasons of (2021/ 2022 and 2022/ 2023) at the experimental farm of Mallawi Agriculture Research Station, Minia Governorate, Egypt. The objective of this study was to illustrate the integrated effect of the mineral nitrogen fertilization and stimulant substances on wheat plants. A split-plot design was used, the main plot was stimulant substances (without, amino acids, seaweed extract and mix of amino acids plus seaweed extract). While the nitrogen fertilization (60%, 80% and 100% from recommended dose (RD), were assigned in sub-plot. The results showed that in most traits there was a significant affect interaction between stimulants and N fertilizer treatments. The highest grain yield (9.490, 9.455 ton ha^{-1}) was obtained by treating wheat with combination of amino acids plus seaweed extract with 80% of Nitrogen Recommended Dose NRD in both seasons of study, respectively. In addition, the increase in mineral contents and protein contents of wheat grain through the same treatment.

Key Words: wheat; productivity; nitrogen fertilizer; amino acids; seaweed extract

INTRODUCTION

Wheat (*Triticum astivum*, L) is considered one of the most essential crops grown in Egypt for both human and an animal nourishment **(Saad *et al*., 2023).** Since increasing wheat productivity is a crucial national aim, many scholars have focused their efforts on increasing wheat production per unit area as well as increasing the cultivated area to close the gap among both Egyptian needs and consumption. The local production of wheat grains (about 10 million tons) sufficient just 60% of the local consumption demand which reflects on the import of wheat **(FAO, 2003).**

Crop productivity depends on nitrogen, excessive use of mineral fertilizers for long time not only cause deterioration, pollution and less productivity of the soil, but also to serious health and environmental problems, For these reasons, several countries around the world altered

their agricultural strategies and used organic and biological fertilizers **(El-Saied and Rashwan, 2021).** Nitrogen is a critical nutrient to provide optimal growth and yield of all agricultural crops. Therefore, maintaining high crop yields while decreasing N fertilizer requirements by improving nitrogen use efficiency in crops is necessary to produce sustainable and environment friendly food. The efficient uptake of more nitrogen by the crop when it needs it, results in enhanced Nitrogen use efficiency derived traits in harvested grain. These results support the agronomic use of this biostimulant with its effect delivered through a defined physiological mode of action that allows up to 27% reduction in N fertilizer usage while maintaining or increasing crop yield. **(Kanter *et al*., 2015, Goñi, *et al*., 2021).**The nitrogen fertilizer applied effects in wheat quality and production nitrogen is the peak important plant nutrient in terms of yield formation. Moreover, nitrogen plays an important role in determining the concentration of protein in grains. Studies showed control of grain nitrogen accumulation by the level of nitrogen fertilizers for wheat **(El-Sorady *et al*., 2022).**

Permanent population growth and soaring fertilizer prices are among the main challenges threating food security worldwide. The stimulants, i.e. amino acids and seaweed extract was found to extent positive effect of plant growth which overcomes the harmful effect of some environmental stress such as drought. An importance of amino acids came from their widely use for the biosynthesis of a large variety of nonproteinic nitrogenous materials, i.e. pigments, coenzymes, some vitamins, pyrimidine bases and purine. Amino acids effect directly or indirectly on the physiological activities of plant growth and productivity. Amino acids play an important role in synthesis of some hormones such as auxins, increasing chlorophyll concentration, consequently increasing photosynthesis and act as chelating factor which help in transport and absorption of micronutrients **(Hammad and Ali, 2014 ; Khalesi *et al*., 2023).** Seaweed extracts are biostimulants for plant growth and quality. As it contains various forms of carbohydrates, amino acids, small quantities of osmoprotectants phytohormones and proteins. Seaweed extracts could be employed as an environmentally friendly and soil-safe alternative to chemical fertilizers.

The objective of this study was to illustrate how reducing nitrogen fertilizers requests and maximizing yield and its attributes besides grain quality of wheat by using stimulant substances (Amino acids and seaweed extract) under conditions of EL- Minia Governorate, Egypt.

MATERIAL AND METHODS

A field experiment was organized at the Experimental Farm of Mallawi Agriculture Research Station, A.R.C., Minia Governorate, Egypt (26° 34' N and 31° 42' E and Elevation 61 meters). Wheat grains (Beni

Suef one) were sown at rate of 148.2 kg ha^{-1} on 20th and 18 th of November in 2021/ 2022 and 2022/ 2023, respectively. Monthly mean temperature, monthly relative humidity, rainfall and wind speed are recorded during seasons of 2021/ 2022 and 2022/ 2023 (Table 1). Physicochemical analysis of the experimental soil during the study seasons is shown in Table (2).

Table (1): Average monthly meteorological data of Minia weather station trough 2021/2022and 2022/2023.

Month	Temperature (°C)			RH%	Wind speed (Km h^{-1})
	Max	Min	Mean		
2021/2022					
November	21.7	8.7	15.2	66	8.4
December	20.4	8.3	14.35	68	8.8
January.	18.2	6.6	12.4	65	8.0
February.	22.5	8.4	15.95	58	7.8
March	25.3	12.5	18.9	48	9.7
April	31.4	16.6	24	36	10.2
May	34.5	17.5	26	41	9.2
2022/2023					
November	20.4	8.4	14.4	67	7.8
December	19.6	7.5	13.55	67	7.7
January.	18.5	6.6	12.55	61	6.6
February.	20.3	6.4	13.36	58	7.6
March	24.8	11.1	17.95	49	8.4
April	30.9	14.3	22.6	41	9.5
May	33.8	16.8	25.3	51	9.6

Table (2): Some physical and chemical properties of the experimental soil (before sowing).

Season	Physical properties				Organic matter g kg^{-1}	E.C. dsm^{-1}	pH	Metal conc.Nutration. (mg kg^{-1})		
	Clay	Silt	Sand	Texture				N	P	K
1st	53.51	26.63	19.86	clay	11.4	1.26	8.15	18.25.	7.58	182.0
2 nd	52.90	27.60	19.50	clay	11.1	1.22	8.25	18.15	7.76	189.0

pH* was determined in soil:water suspension (1:2.5soil-water suspension). EC** was determined in soil paste extract.

Treatments and experimental design layout.

In this experiment, nine treatments laid out in a split plot design with three replications. Stimulant treatments occupied the main plots, while nitrogen fertilizer levels were arranged in the sub plots.

Main plots (Stimulant substances):

1- Without .
2- Amino acids (AC). The foliar solution volume (617.5g / 495 liter of water /ha and spraying was conducted sprayer (for experimental plots) until saturation point three times. Using drops of Tween-20 as a wetting agent, Table (3).
3- Seaweed extract (SE). sprayable *Ascophyllum nodosum* extract Table (4)
4- Combination of amino acids plus seaweed extract.

Foliar application was performed three times at early morning during the growing seasons, the first one was conducted 30 days from planting and the rest were applied at 15 days intervals

Sub-plots (Levels of nitrogen fertilizer as a percentage of recommended dose):

1- 60% Nitrogen Recommended Dose (NRD) 107 kg N ha^{-1}.
2- 80 % Nitrogen Recommended Dose (NRD) 143 kg N ha^{-1}.
3- 100 % Nitrogen Recommended Dose (NRD) 179 kg N ha^{-1}.

The soil was prepared by two orthogonal plowings, followed by leveling the soil and dividing it into the experimental plots (3 × 3.5 m). Nitrogen fertilizer in the form of ammonium nitrate (33.5% N) was added at rates of 107, 143 and 179 kg N ha^{-1} in three equal doses, the first N dose (20%) was added at sowing time, while, 40 % was applied at 25 days after sowing. Finally, the third dose equivalent to 40 % was applied 50 days after sowing. During the soil preparation, 370.5 kg ha^{-1} of calcium superphosphate (15.5 % P_2O_5) was applied. Along with the initial dosage of potassium fertilizer, 123.5 kg ha^{-1} (48% k_2O) of potassium fertilizer in the form of potassium sulfate (48 % K_2O).

Studied characters:

1- photosynthetic pisgment content.

- Chlorophylls (a.b and a+b) and carotenoid (mg g^{-1} f. wt)

Three plant samples were randomly taken from each plot were estimated on the 4th leaf from the plant apex. Chlorophyll a, chlorophyll b and carotenoids Pigments content was determined as to the method mentioned by **Saric *et al.*, (1976)**

2- Growth characters:

- Plant height (cm).

3- **Yield and its components:**

- One-thousand grains weight (g).
- Grain yield (ton ha^{-1}). (ton = 1000kg)
- Straw yield (ton ha^{-1}).
- Biological Yield (ton ha^{-1})

2- Grains quality: At harvest, grain and straw yields were taken from each plot to determine their contents of total nitrogen by the modified Micro-kjeldahl apparatus as described by **Jones *et al.*, (1991).** Total phosphorus content was estimated spectrophotomitrically by model No. UV2100 S/N: BH 16041603003. Power source AC220V/50Hz. FUSE: 250V/ 3.15A FAST- ACTING. according to **Peters *et al.*, (2003).** Total potassium content was determined by photometerically by JENWAY PFP7 model according to **Peters *et al.*, (2003).**

3- **Uptake =** N content × yield
(Kg ha^{-1}) g kg^{-1} ton ha^{-1}

4- **Crude protein percentage in grains** (%) was calculated by multiplying N content by 5.75 **(Ranganna, 1977).**

5- Total free amino acids (%) were determined according to **Jayaraman (1985).**

6- **Statistical analysis**

All collected data were subjected to analysis of variance according to **Gomez and Gomez (1984).** All statistical analysis was performed by using analysis of variance technique with means of CoStat computer software package **(CoStat, Ver. 6.311., 2005)**. The least significant differences (LSD at 0.05) used to compare the treatment's means.

Table (3): Some physical and chemical characters s of amino acids (g 100^{-1} ml solution).

Parameter	*value*
Colour	Brown
pH	5.7
OM	18.4
Aspartic acid	1.56
Glutamic acid	2.62
Serine	2.21
Glycine	1.78
Histidine	0.14
Arginine	1.66
Threonine	1.02
Proline	2.55
Tyrosine	0.40
Methionine	0.08
Leucine	1.77
Lysine	0.33
Valine	1.74
Cystine	0.87
Phenylalanine	0.94
Alanine	1.41
Isoleucine	1.07
amino nitrogen	1.4

Table (4): Physico-chemical characters and amino acids analysis (mg g^{-1} dry weigh) of seaweed extracts

Parameter		*value*	Amino acid	*value*
Colour		Green		
pH		6.66	Aspartic acid	5.27
Ash (%)		36.25	Glutamic acid	7.08
Protein (%)		5.39	Serine	4.42
Lipid (%)		1.09	Glycine	5.19
Carbohydrate (%)		5.41	Histidine	1.32
Nutrients (mg L^{-1})	N	252.0	Arginine	3.88
	P	8.39	Threonine	4.60
	Ca	0.41	Proline	2.55
	Mg	0.49	Tyrosine	1.26
	K	118.79	Methionine	8.12
	Na	47.51	Leucine	5.52
	Fe	3.92	Lysine	7.32
	Zn	0.59	Phenylalanine	27.32
	Cd	0.028	Essential	54.20
	Cu	0.58	Non-essential	29.65
	Pb (mg L^{-1})	0.60	Total amino acids	83.85

RESULTS AND DISCUSSION

Growth, yield and its components parameters

Table (5) showed that foliar spraying of combination of amino acids plus seaweed extract significantly increased compared with untreated plants in both seasons. In this concern, plant height increased by (14.05 and 12.82 %), while grain yield increased by (22.00 and 22.15%) straw by (12.29 and 13.82%), Biological yield by (15.46 and 16.54%) and 1000 grain weight by (8.29 and 8.16%), for 1st and 2nd seasons, respectively. It is obvious from the same data that fertilization treatments recorded positive impact on wheat plants. The highest increases were found by addition of 100% of NRD resulted in significant increases in plant height, grain yield, straw, biological yield and 1000 grain by (8.88, 9.99%; 23.45, 18.41%; 22.63, 20.55%; 18.57, 15.65% and 5.99, 5.91% for both two season, respectively compared with the control. Concerning with interaction between stimulants substances and N fertilizer, the highest grain yield (9.490 and 9.455 ton ha^{-1}) was obtained by treating wheat with combination of amino acids plus seaweed extract with 80% of NRD in both seasons of study. This treatment also enhanced considerably plant height (101.13 and 100.71cm), straw yield (18.451 and 18.514ton ha^{-1}), biological yield (27.491 and 27.969 ton ha^{-1}) and 1000 grain weight (61.01and 61.22 g).

In this respect, increases of yield and yield components could be attributed to the beneficial effect of seaweed and amino acids to increase growth characteristics . This might be due to their roles in enhancing many physiological processes including nutrients uptake by roots and their metabolism. Amino acids was suggested to participate in a beneficial role during vegetative and reproductive growths **(Chah-Nasir *et al*., 2023)** through improving flower formation and their set in some plants due to its high auxin and cytokinins content and enhancement carbohydrates accumulation, enhanced cell division and nutritional status resulting in increasing number of leaves and dry weight of leaves, stems and roots. **(Hammad, and Ali, 2014)**. The results display the positive role of adding nitrogen fertilizer and seaweed extract in raising the efficiency of using wheat for nitrogen fertilizer by reducing 20% of its recommended amount and the positive effect of that in improving plant growth and development by increasing the availability of the necessary nutrients and raising the efficiency of the root total to absorb these elements, as a result, increase the efficiency of the photosynthesis process, produce high rates of dry matter in the vegetative growth stage,

and increase its transmission and accumulation in the reproductive parts of the plant, which is reflected positively on increases the process of pollination and fertilization, then increasing the total yield as well as improving the quality of grains **(Jabbar, and Kadhum,2021)**. These results matched with **Hemdan *et al.*, (2023).**

Table (5): Effect of nitrogen fertilizers and stimulant substances (amino acids, and seaweed extract) and their interactions on plant height (cm), grain yield (ton ha^{-1}), straw yield (ton fed^{-1}), Biological yield (ton ha^{-1}) and 1000-grain weight (g) of wheat.

		Plant height (cm)							
		Nitrogen levels (B)				Nitrogen levels (B)			
		60%	80%	100%	mean	60%	80%	100%	mean
		First Season				Second Season			
Stimulant (A)	without	80.44f	84.21f	95.03c	86.56c	80.61f	85.01e	95.81c	87.14c
	AC	91.11fe	93.78cd	97.45b	94.11b	91.45d	94.03c	97.91b	94.46b
	SE	91.66e	94.02c	97.55b	94.41b	91.62d	94.25c	98.05b	94.64b
	AC&SE	95.02c	101.13a	100.02a	98.72a	95.32c	100.71a	100.21a	98.31c
	mean	89.56c	93.29b	97.51a	95.3	89.75c	93.5b	98.72c	93.75
LSD		A=1.002	B=1.102	A*B=1.211		A=2.001	B=1.241	A*B=1.204	
		Grain yield (ton ha^{-1})							
Stimulant (A)	without	5.821e	7.741de	9.012bc	7.525c	5.882e	7.942cd	8.712c	7.512c
	AC	7.656d	8.545c	9.185b	8.462b	7.771de	8.682c	8.815b	8.423b
	SE	7.712d	8.625c	9.205b	8.514b	7.812d	8.691c	8.799b	8.434b
	AC&SE	8.632c	9.49a	9.41a	9.177a	8.692c	9.455a	9.382a	9.176a
	mean	7.455c	8.600b	9.203a	8.420	7.539c	8.693b	8.927a	8.368
LSD		A = 0.301	B = 0.212	A*B = 0.201		A=0.201	B=0.101	A*B= 0.221	
		Straw yield (ton ha^{-1})							
Stimulant (A)	without	13.521	14.888	17.745	15.385	13.754	15.012	17.771	15.512c
	AC	14.88d	15.235c	17.815b	15.977b	15.022d	15.892c	17.985b	16.300b
	SE	14.892d	15.324c	17.821b	16.012b	15.11d	15.912c	18.011b	16.344b
	AC&SE	15.122c	18.451a	18.254a	17.276a	16.012c	18.514a	18.441a	17.656a
	mean	14.604c	15.975b	17.909a	16.163	14.975c	16.333b	18.053a	16.453
LSD		A=0.701	B=0.925	A*B= 0.421		A=0.914	B=1.002	A*B=0.422	
		Biological Yield (ton ha^{-1})							
Stimulant (A)	without	19.342e	22.629d	26.757b	22.910c	19.636e	22.954d	26.483bc	23.024c
	AC	22.536de	23.780cd	27.000ab	24.439b	22.793d	24.574cd	26.800b	24.723b
	SE	22.604d	23.949c	27.026ab	24.526b	22.922d	24.603cd	26.810b	24.778b
	AC&SE	23.754cd	27.941a	27. 664a	26.453a	24.704c	27.969a	27.823a	26.832a
	mean	22.965c	25.223b	27.230a	25.140	23.473c	25.716b	27.146a	25.445
LSD		A=0.701	B=0.925	A*B= 0.421		A=0.914	B-1.002	A*B=0.422	
		1000-grain weight(g)							
Stimulant (A)	without	52.22f	55.25e	57.12bc	54.86c	52.51f	55.41e	57.82c	55.25c
	AC	56.24d	57.62bc	58.89b	57.58b	56.54d	57.89c	59.04b	57.82b
	SE	56.26d	57.71bc	59.01b	57.66b	56.61d	58.04bc	59.24b	57.96b
	AC&SE	57.12c	61.01a	60.11a	59.41a	57.66cd	61.22a	60.41a	59.76a
	mean	55.46c	57.90b	58.78a	57.38	55.83c	58.14b	59.13a	57.70
LSD		A=0.202	B=0.451	A*B=0.198		A=0.222	B=0.481	A*B=0.944	

It is evident from the results of Table (6) that the stimulants had a significant effect in increasing the chlorophyll (a, b and a+b), carotenoids and total free amino acids (%.) content of leaves treatment of foliar spraying with amino acids and seaweed extract recorded the highest average for chlorophyll (a, b and a+b) (mg g $^{-1}$ f. wt), carotenoids (mg g $^{-1}$ f. wt**)** and total free amino acids (%.) compared to the comparison

treatment (without) , which recorded the lowest average. Seaweed products contain growth regulators (auxins, cytokinine and gibberellins), amino acids and mineral nutrients, that accordingly positively affect plant growth and division as reported by **Mohy El-Din (2016)**, the reason for the increase in chlorophyll (a, b and a+b) (mg g $^{-1}$ f. wt), carotenoids (mg g $^{-1}$ f. wt**)** and total free amino acids (%.)

Table (6): Effect of nitrogen fertilization and stimulant substances (amino acids, and seaweed extract) and their interactions on chlorophyll (a, b and a+b) (mg g $^{-1}$ f. wt), carotenoids (mg g $^{-1}$ f. wt) and total free amino acids (%) of wheat

		Chl a (mg g $^{-1}$ f. wt)							
		Nitrogen level (B)				Nitrogen level (B)			
		60%	80%	100%	mean	60%	80%	100%	mean
		First Season				Second Season			
	without	0.492g	0.528f	0.671c	0.564c	0.498g	0.538f	0.678c	0.571c
Stimulant (A)	AC	0.580e	0.639d	0.705b	0.641b	0.585e	0.645cd	0.708b	0.646b
	SE	0.584e	0.642cd	0.709b	0.645b	0.589e	0.649cd	0.711b	0.650b
	AC&SE	0.612de	0.777a	0.775a	0.721a	0.625d	0.789a	0.786a	0.733a
	mean	0.567c	0.647b	0.715a	0.643	0.574c	0.655b	0.721a	0.65
LSD		A = 0.028	B = 0.012	A*B = 0.019		A = 0.016	B = 0.018	A*B = 0.024	
		Chl b (mg g -1 f. wt)							
	without	0.181h	0.205f	0.321c	0.236c	0.187h	0.209g	0.332c	0.243c
Stimulant (A)	AC	0.197g	0.245d	0.340b	0.261b	0.202gh	0.251e	0.349b	0.267b
	SE	0.201f	0.249d	0.345b	0.265b	0.208g	0.257d	0.354b	0.273b
	AC&SE	0.231e	0.396bc	0.394a	0.340a	0.238f	0.402a	0.395a	0.345a
	mean	0.203c	0.274b	0.350a	0.276	0.209c	0.280b	0.358a	0.282
LSD		A = 0.008	B = 0.011	A*B = 0.021		A = 0.002	B = 0.009	A*B = 0.011	
		Chl a+b (mg g $^{-1}$ f. wt)							
	without	0.654h	0.692g	0.785e	0.710d	0.661g	0.699f	0.792e	0.717d
Stimulant (A)	AC	0.777f	0.785e	0.843d	0.802c	0.787ef	0.797e	0.863d	0.816c
	SE	0.884cd	0.891c	1.054bc	0.943b	0.896c	0.906b	1.065ab	0.956b
	AC&SE	1.045bc	1.173a	1.162ab	1.127a	1.057	1.191a	1.176a	1.141a
	mean	0. 840c	0.885b	0.961a	0.896	0.850c	0.898b	0.974a	0.908
LSD		A = 0.022	B = 0.018	A*B = 0.021		A = 0.025	B = 0.019	A*B = 0.023	
		Carotenoids (mg g $^{-1}$ f. wt)							
	without	0.281i	0.305h	0.352d	0.313d	0.283i	0.307h	0.355d	0.315d
stimulant (A)	AC	0.315g	0.335ef	0.375c	0.342c	0.32fg	0.382bc	0.391b	0.364c
	SE	0.319g	0.339ef	0.381b	0.346b	0.326f	0.389bc	0.395b	0.370b
	AC&SE	0.332ef	0.492a	0.481ab	0.435a	0.338e	0.497a	0.485ab	0.440a
	mean	0.312c	0.368b	0.397a	0.359	0.317c	0.394b	0.407a	0.373
LSD		A = 0.030	B = 0.012	A*B = 0.018		A = 0.023	B = 0.016	A*B = 0.024	
		Total free amino acids %							
	without	1.02h	1.31g	1.99de	1.44c	1.05h	1.37g	2.01cd	1.48c
stimulant (A)	AC	1.40f	2.03d	2.78c	2.07b	1.44ef	2.08cd	2.82b	2.11b
	SE	1.41f	2.06d	2.81c	2.09b	1.46ef	2.13c	2.85b	2.15b
	AC&SE	1.81e	3.42a	3.32ab	2.85a	1.88d	3.46a	3.36a	2.90a
	mean	1.41c	2.21b	2.73a	2.11	1.46c	2.26b	2.76a	2.16
LSD		A = 0.009	B = 0.01	A*B = 0.020		A = 0.008	B = 0.012	A*B = 0.022	

As for nitrogenous fertilizer, the addition treatment of 100 % NRD increased the content of leaves of chlorophyll (a, b and a+b) (mg g $^{-1}$ f. wt), carotenoids (mg g $^{-1}$ f. wt**)** and total free amino acids (%.) and achieved (0.715 & 0.721, 0.350& 0.358, 0.961& 0.974, 0.397 & 0.407 and 2.73 & 2.76), respectively followed by the treatment of 80 % NRD.

Conversely, the interaction between stimulants and N fertilizer treatments showed a significant effect of the interaction for the chlorophyll (a, b and a+b) (mg g^{-1} f. wt), carotenoids (mg g^{-1} f. wt**)** and total free amino acids (%.) of leaves, as the highest value was found for the plants treated with amino acids plus seaweed extract with 80% of NRD (0.777, 0.786; 0.396, 0.365; 1.173, 1.191; 0.492, 0.497 and 3.42, 3.46) for both two season, respectively.

The increases may be attributed to the role of seaweed extracts and amino acids in providing additional quantities of nutrients, which reflected positively on the increase in the amount of chlorophyll, and the chloroplasts plus it contains some amino acids and growth regulators that increase the activity of the vital processes of the plant **(Faisal *et al.*, 2013 ; Jabbar & Kadhum, 2021, Khalesi *et al.*, 2023 and Chah-Nasir *et al.*, 2023).** Moreover, nitrogen enters the formation of the porphyrin rings that enter into the formation of the basic chlorophylls for the processes of photosynthesis and respiration, as well as its entry into the formation of the enzymatic accompaniments which are auxiliary factors for enzymes or other nitrogen-containing compounds in the plant as well as in the formation of energy compounds, especially ATP (Adenosine triphosphate), and this is consistent with what was mentioned by **(Muhanna *et al.*, 2015 ; Jabbar and Kadhum, 2021 and Shafie *et al.*, 2021).**

The results of the statistical analysis shown in Table 7 and 8 indicate that different applied stimulants as amino acids, seaweed extract and combination of (amino acids plus seaweed extract) significantly increased N,P and K% in grains and straw, total N. uptake (kg ha^{-1}) and protein % of wheat. Also, foliar spraying of combination between amino acids plus seaweed extract gave the highest values during 1^{st} and 2^{nd} seasons, reaching (1.259, 1.262; 0.412, 0.414; 0.791, 0.794; 0.386, 0.389; 0.107, 0.101; 1.501, 1.492; 182.96, 184.94 and 11. 55, 11.58), respectively compared to the untreated plants. As for nitrogen fertilizer levels, the results of the statistical analysis showed significant differences between its three levels (60, 80 and 100% of NRD). At level 100 % of NRD fertilizer recorded the highest values of all characters (1.277, 1.231; 0.399, 0.401; 0.709,0.721; 0.372, 0.375; 0.108, 0.108; 1.494, 1.495; 179.56, 189.90 and 11.29, 12.22) compared to 80 and 60% of NRD, respectively.

With regard to the interaction between applied foliar application of stimulants substances and N fertilizer treatments, the recorded data indicated that sprayed with combination between amino acids plus seaweed extract with 80% of NRD achieved the highest values for N,P and K% contents in grains and straw, total N. uptake and Protein % content.

Plants treated with amino acids and seaweed extracts have shown generally improved nutrient acquisition capabilities and improved growth and vigor. This improvement can be attributed to the better plant nutrition and nutrient efficiency provided by amino acids and seaweeds

and their synergistic effects with N fertilizers. In fact, seaweeds stimulates plant growth and the absorption of various crucial nutrients, such as nitrogen and phosphorus **(Lamlom *et al.*, 2023 and Ali *et al.*, 2021).** They also induce phytohormonal responses due to their specific components and interaction with plant growth regulation. Treatment by seaweed extracts and products also causes significant changes in the components of soil and plant in support of sustainable plant growth, which highlights the role of multiple components and their complex interactive effects on plant growth processes. Moreover, amino acids and seaweeds stimulates plant growth and the absorption of various crucial nutrients, such as nitrogen and phosphorus and potassium, under challenging environments, **Lamlom *et al.*, (2023) and Ali, *et al.*, (2021).** The increase in N, P and K% in grains & straw, total N uptake and protein % may be due to the increase in nitrogen content in the grain, as nitrogen enters the formation of amino acids.

Table (7): Effect of nitrogen fertilization and stimulant substances (amino acids, and seaweed extract) and their interactions on N% in grain, N% in straw, Total N up take mg kg^{-1} and Protein % of wheat.

		N% in grain							
		Nitrogen level (B)				Nitrogen level (B)			
		60%	80%	100%	mean	60%	80%	100%	mean
		First Season				Second Season			
Stimulant (A)	without	0.771g	0.812f	1.122d	0.902c	0.775f	0.818e	1.129cd	0.907c
	AC	0.988e	1.211c	1.249b	1.149b	0.992d	1.216c	1.251b	1.153b
	SE	0.989e	1.213c	1.251b	1.151b	0.998d	1.217c	1.254b	1.156b
	AC&SE	1.203cd	1.289a	1.286a	1.259a	1.205d	1.291a	1.289a	1.262a
	mean	0.988c	1.131b	1.227a	1.115	0.993c	1.136b	1.231a	1.120
LSD		A= 0.006 B=0.008 A*B= 0.005				A= 0.008 B=0.010 A*B= 0.005			
N% in straw									
Stimulant (A)	without	0.251g	0.291f	0.305d	0.282c	0.259g	0.298f	0.310e	0.289c
	AC	0.325e	0.339cd	0.387b	0.350b	0.328d	0.343c	0.389b	0.353b
	SE	0.328e	0.342c	0.385b	0.352b	0.332d	0.347c	0.388b	0.356b
	AC&SE	0.335d	0.414a	0.409a	0.386a	0.339cd	0.416a	0.411a	0.389a
	mean	0.310c	0.347b	0.372a	0.343	0.315c	0.351b	0.375a	0.347
LSD		A= 0.009 B=0.011 A*B= 0.007				A= 0.008 B=0.014 A*B= 0.006			
Total N uptake Kg ha^{-1}									
Stimulant (A)	without	78.80f	106.18e	155.70c	111.27c	81.22g	109.71f	153.45d	112.97c
	AC	124.00d	155.13c	183.66b	153.16b	126.36e	160.08c	180.24b	154.66b
	SE	125.12d	157.03c	183.78b	154.36b	128.13e	160.98c	180.22b	155.68b
	AC&SE	154.5c	198.72a	195.67a	182.96a	159.02c	199.08a	196.72a	184.48a
	mean	119.03c	152.70b	179.56a	149.32	122.03c	156.08b	189.90a	150.84
LSD		A= 18.009 B=20.021 A*B= 11.007				A= 15.012 B=12.011 A*B= 18.012			
Protein %									
Stimulant (A)	without	4.49g	6.39f	10.11d	6.79c	4.56g	6.50f	9.84d	6.81c
	AC	7.56ef	10.35de	11.47cd	9.72b	7.71e	10.57c	11.03b	9.71b
	SE	7.63e	10.46d	11.52c	9.80b	7.80e	10.58c	11.03b	9.75b
	AC&SE	10.38de	12.23a	12.10ab	11.55a	10.47cd	12.21a	12.09a	11.58a
	mean	7.37c	9.73b	11.29a	9.39	7.49c	9.88b	12.22a	9.37
LSD		A= 0.072 B=0.087 A*B= 0.051				A= 0.069 B=0.187 A*B= 0.042			

Table (8): Effect of nitrogen fertilization and stimulant treatments (amino acids, and seaweed extract) and their interactions on P and K% in grains and straw of wheat..

		P% in grain							
		Nitrogen levels (B)				Nitrogen levels (B)			
		60%	80%	100%	mean	60%	80%	100%	mean
		First Season				Second Season			
Stimulant (A)	without	0.361f	0.371de	0.382d	0.371c	0.363g	0.374f	0.384de	0.374c
	AC	0.373de	0.375de	0.391c	0.380bc	0.375ef	0.377e	0.392d	0.381bc
	SE	0.376de	0.395bc	0.401b	0.391b	0.377e	0.396cd	0.403b	0.392b
	AC&SE	0.392c	0.423a	0.421a	0.412a	0.394cd	0.425a	0.423a	0.414a
	mean	0.376c	0.391b	0.399a	0.389	0.377c	0.393b	0.401a	0.390
LSD		A= 0.006 B=0.008 A*B= 0.005				A= 0.008 B=0.010 A*B= 0.005			
P% in straw									
Stimulant (A)	without	0.091h	0.101d	0.105c	0.099c	0.092g	0.100c	0.105b	0.099c
	AC	0.095g	0.104cd	0.107b	0.102bc	0.094f	0.103bc	0.106b	0.101b
	SE	0.097f	0.105c	0.109b	0.104b	0.095e	0.103bc	0.109ab	0.102b
	AC&SE	0.099e	0.112a	0.110a	0.107a	0.098d	0.111a	0.110a	0.106a
	mean	0.095c	0.106b	0.108a	0.103	0.095c	0.104b	0.108a	0.102
LSD		A= 0.009 B=0.011 A*B= 0.007				A= 0.008 B=0.014 A*B= 0.006			
K % in grain									
Stimulant (A)	without	0.433f	0.531c	0.543de	0.502d	0.436e	0.535d	0.543d	0.505c
	AC	0.482e	0.643cd	0.659c	0.595c	0.484e	0.646c	0.701b	0.610b
	SE	0.485e	0.647cd	0.704b	0.612b	0.486e	0.651c	0.707b	0.615b
	AC&SE	0.512c	0.931a	0.929a	0.791a	0.514d	0.936a	0.932a	0.794a
	mean	0.478c	0.688b	0.709a	0.625	0.480c	0.692b	0.721a	0.631
LSD		A= 0.009 B=0.007 A*B= 0.021				A= 0.012 B=0.011 A*B= 0.023			
K% in straw									
Stimulant (A)	without	1.418g	1.462e	1.489cd	1.456c	1.421f	1.466d	1.487bc	1.458c
	AC	1.428f	1.481d	1.492c	1.467b	1.430e	1.481c	1.494b	1.468b
	SE	1.429f	1.485d	1.494c	1.469b	1.431e	1.484bc	1.494b	1.470b
	AC&SE	1.463e	1.503a	1.501ab	1.489a	1.466d	1.506a	1.504a	1.492a
	mean	1.435b	1.483b	1.494a	1.470	1.437c	1.484b	1.495a	1.472
LSD		A= 0.072 B=0.087 A*B= 0.051				A= 0.069 B=0.187 A*B= 0.042			

CONCLUSIONS

Excessive use of nitrogen fertilizers not only cause deterioration, pollution and less productivity of the soil, but also to serious health and environmental problems. So, the current study showed that reducing nitrogen fertilizers by using some stimulants substances like amino acids, seaweed extract that significantly improved growth, yield, and grain chemical constituents of wheat plants.

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ترشيد الأسمدة النيتروجينية باستخدام بعض المحفزات لتحسين إنتاجية وجودة نبات القمح تحت ظروف محافظة المنيا

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أجريت تجربة حقلية خلال موسمين شتويين متتاليين (2021/ 2022 و 2022/ 2023) بالمزرعة التجريبية بمحطة بحوث ملوي الزراعية بمحافظة المنيا، مصر. تهدف هذه الدراسة إلى توضيح التأثير المتكامل للتسميد النتروجيني غير العضوي والمواد المنشطة على نباتات القمح. تم استخدام تصميم القطع المنشقة، وكانت القطعة الرئيسية عبارة عن مواد محفزة (بدون رش و أحماض أمينية ومستخلص الطحالب البحرية وخليط الأحماض الأمينية ومستخلص الطحالب البحرية)، بينما تم التسميد بالنيتروجين (60%، 80%، 100% نيتروجين من الجرعة الموصي بها و هي 107 و143 179 كجم نيتروجين للهكتار). بالقطع الفرعية.

أظهرت النتائج ان التداخل بين المحفزات و الاسمدة النيتروجينية كان له تأثيرات معنوية في معظم الصفات ، حيث تم الحصول على أعلى انتاجية (9,490 & 9.455 طن / هكتار) بمعاملة القمح بمزيج من الأحماض الأمينية ومستخلص الأعشاب البحرية مع 80% نيتروجين من الجرعة الموصي بها.في كلا الموسمين الدراسة بالإضافة إلى زيادة محتوى العناصرالغذائية ومحتوى البروتين في حبوب و قش القمح من خلال نفس المعاملة.