

EFFECT OF AMINO ACIDS AND NANO FERTILIZERS ON GROWTH CHARACTERS OF TWO VARIETIES OF RYE WHEAT

Rayan F. Ahmed^{1*}, Amjad T. Khalil² and Ari S. Yassin³

¹ Department of Field Crops, College of Agriculture and Forestry, University of Mosul, Iraq

² Plant Production Dept., Agriculture Directorate Nineveh, Ministry of Agriculture, Iraq

³ Directorate of Research and Extension, Ministry of Agriculture and Water Resources. Erbil.
Iraq

*Corresponding author E Mail: rayanobody79@uomosul.edu.iq

Abstract: This study was carried out during the winter agricultural season 2021-2022 at Telkaif site north of Mosul city to study the effect of two varieties of rye wheat (Sara and Rizan) and seven treatments of soaking of the two varieties grains with polyamine amino acids and N₂₀P₂₀K₂₀ nano fertilizer in concentrations (0, 2000, 4000 ppm amino acids, 1500, 3000 ppm nano- Fertilizer, 2000 ppm amino acids + 1500 ppm nano- Fertilizer, 4000 ppm amino acids + 3000 ppm nano- Fertilizer) for growth traits under rainfed conditions. The experiment was carried out in the field according to the randomized complete block design (R.C.B.D.) with split plot system with three replications. The results indicated that the Sara Variety was significantly superior in the CCI (40.6), NTS (266.2) tiller.m⁻², LA (27578.0) cm² and the LAI (2.8). Soaking treatment with NPK 1500 ppm was superior in in all attributes. Dual interactions between Sara variety and soaking treatment with NPK 1500 ppm recorded the highest rate in most of the studied traits.

Key words: nano fertilizer, amino acids, varieties, growth traits.

Introduction

Rye wheat (Triticale) is the first cereal crop produced by man that combines the characteristics of wheat (Triticum) and rye (Secale), which has the characteristics of a new compound that may outperform the current cereal crops, as it combines the high yield and high protein content of wheat with the ability to withstand conditions the harsh environment and high content of lysine for rye as well as its use in ruminant and poultry diets (El-Matually, et.al, 2012). The rate of production of rye wheat per unit area in Iraq is below the required level compared to neighboring countries such as Jordan and Kuwait. In fact, there are many factors responsible for the decline in the productivity of rye wheat, among the most important of these factors is the lack of rain Or falling at times inappropriate for the plant's need and thus negatively affects the growth and emergence of the plant to include the morphological, physiological and biochemical characteristics, and this leads to a reduction in the size of the plant and its leaf area, and consequently, the lack of yield (Ashraf & Foolad, 2005), Therefore, it is necessary to search for suitable methods that help the plant to tolerance drought and give good plants, and among these methods is the technique of soaking seeds, which means soaking the seeds with water or chemical solutions before planting them for a specific period of time without allowing them to germinate and re-drying them to their original moisture and then replanting them after that, It may improve the vital activity of the seeds, especially the

relatively degraded seed, It also reduces the time between sowing seeds and the emergence of seedlings, accelerating and homogenizing the germination and thus obtaining the optimum plant density and reducing the competition of the weeds and its reflection on the vegetative growth of the plant, which leads to giving plants that are able to tolerance stresses and unfavorable environmental conditions (Iqbal, et al., 2015).

The use of nanotechnology is one of the most important modern technologies and is considered an effective alternative to traditional fertilizers due to the small size of its particles, which are (1-100) nanometers, and thus nano-fertilizers increase the absorption of nutrients easily, as both the surfaces of the leaves and the root of the plant are the gateway to enter the main nutrients for plants, which facilitates Their penetration with nanomaterials, and thus nanofertilizers facilitate the complex absorption process using molecular carriers or through internal cellular channels (Matronardi, et al., 2015). These nanomaterials also increase the plant's ability to resist diseases, Unfavorable conditions and an increase in the efficiency of fertilizer use as a result of its easy penetration into plant cells, which is reflected in the characteristics of growth and agricultural production (Ghorbani et al., 2011).

The importance of amino acids comes through increasing the plant's ability to withstand unfavorable environmental stress conditions such as temperatures, low humidity, increased salinity, and others, as well as being one of the main cellular components of the plant that contribute to the formation of chlorophyll, thus increasing the rate of photosynthesis and regulating the number of branches in the plant and its reflection In the growth and components of the yield and the quality of protein and increase its quantity (Mohamad, et al., 2016).

This research was conducted by treating the seeds of two varieties of rye wheat with amino acids and the compound fertilizer $N_{20}P_{20}K_{20}$ nano, in order to study their different soaking solutions in the growth characteristics of rye wheat.

Materials & Methods

This study was conducted during the winter agricultural season 2021-2022 at Telkaif site north of Mosul city to study the effect of two varieties of rye wheat (Sara and Rizan) and seven treatments of the two varieties grains with polyamine amino acids and $N_{20}P_{20}K_{20}$ nano-fertilizer in concentrations (0, 2000, 4000 ppm amino acids, 1500, 3000 ppm nano- Fertilizer, 2000 ppm amino acids + 1500 ppm nano- Fertilizer, 4000 ppm amino acids + 3000 ppm nano- Fertilizer) where the grains were soaked for 12 hours in water solutions represented by polyamine and $N_{20}P_{20}K_{20}$ nano fertilizer, then the grains were left for air drying at room temperature (25 C°) until it is planted.

Experiment Parameters

Nano-fertilizer NPK 20:20:20: a fertilizer with ultra-fine particles that dissolves completely in water and is used to legalize the use of fertilizers .

POLY AMIN: It is an organic compound in the form of a water-soluble powder that contains 90% amino acids that has the ability to stimulate the plant to overcome stress conditions.



Each experimental unit contained four lines with a length of (1 m) for each line, with a distance of (25 cm) between one line and another, leaving a distance of (1 m) between one experimental unit and another and a distance of (1 m) between one repeater and another. The weeds was controlled manually twice. The physical and chemical properties of the soil were analyzed at a depth of 0-30 cm) in the soil testing laboratories of the Environmental Protection and Improvement Department / Dohuk (Table 1). The data on rainfall was also obtained from the Nineveh Agriculture Directorate / Planning Department, as shown in Table (2).

Studied characteristics

Plant Height (cm) (PH): Measured from the soil surface to the top of the plant.

Chlorophyll Content Index (CCI) : Measurement before flowering was done with a manual field instrument (chlorophyll meter SPAD-502) supplied by Minolta Co., Japanese ltd.

Total Tillers Number.m⁻² (TTN): was calculated from the midlines at the beginning of the flowering stage .

Number of Leaves.Tiller⁻¹(NLS): was calculated from the midlines at the beginning of the flowering stage.

Leaf Area (cm²) (LA) : was measured through the following law (length * width * 0.95), where a sample was taken and then proportionally converted to square metres, and the leaf area was measured at the end of the spikes stage and the beginning of flowering, in which the leaf area reached to Maximum.

Leaf Area Index (LAI): was calculated by dividing the total area of plant leaves in one square meter by an area of one square meter of land.

Table (1): Experimental soil specifications to the Talkef location

Clay (g.kg ⁻¹)	Silt (g.kg ⁻¹)	Sand (g.kg ⁻¹)	Textura l	Available N (mg.kg ⁻¹)	Availabl e p (mg.kg ⁻¹)	Availabl e k (mg.kg ⁻¹)	organic matter	PH	EC (dc/ m(
20.3	45.2	34.5	Loam	670	48.07	260	1.22	7.3	0.26

Table (2) The average rainfall for the season 2021-2022 for Telkef Location

Month – year	October (2021)	November (2021)	December (2021)	January (2022)	February (2022)	March (2022)	April (2022)	May (2022)	Total /mm
Talkif	0	0	76	117	16.5	24	13	31	278

Statistical analysis

data were analyzed statistically according to the Randomized Complete Block Design (R.C.B.D.) with split plot system with three replications, and the Duncan multi – range test at the probability level 1 and 5% was used to compare the averages.

Results & Discussion

Plant Height (cm) (PH)

The Table (3) show no significant variance between Sara and Rizan variety in the trait (PH), as the two average varieties achieved (83.0 and 81.3) cm, respectively. The reason for the lack of differences between varieties of rye wheat in this trait may be due to the fact that this trait is largely governed by genetic action. This finding is in agreement with Muhova & Kirchev (2020).

In the soaking treatments, all the soaking treatments were superior compare to the control treatment, and the highest value was in the soaking treatment with NPK 1500 ppm (84.0) cm, without significant difference from the treatments PA 2000 ppm and PA 2000 ppm + NPK 1500 ppm, and the reason for the increase in plant height at Soaking treatment with NPK nano compound fertilizer (1500 ppm) indicates the role of compound fertilizer from major elements in increasing plant height, especially nitrogen element that inhibits the activity of the oxidizing enzyme of the auxin growth regulator, The level of auxin inside the plant increases, thus increasing the absorption of large amounts of nutrients, which is ultimately reflected in the elongation of the phalanges (Valizadeh & Milic, 2016). This result is similar with (Al-Juthery, et al., 2018) and (Kandle & Marie, 2017).

The interaction between the varieties and the soaking treatments, showed superior the interaction of Sara variety with the soaking treatments with PA 2000 ppm (84.1) cm, NPK 1500 ppm (85.1) cm, PA 2000 ppm + NPK 1500 ppm (85.3) cm, respectively compared with the control treatment.

Table(3):Effect of Varieties and Amino acids and Nanofertilizers on Plant

Height(cm) .

Amino acids and Nanofertilizers	Varieties		Means of Amino acids and Nanofertilizers
	Sara	Rizan	
Control	80.0 ±2.0 de	79.1 ±1.1 e	79.5 ±1.3 c
PA 2000 ppm	84.1 ±1.4 ab	81.6 ±0.9 cd	82.8 ±0.4 ab

PA 4000 ppm	82.7 ±1.1 bc	81.4 ±1.2 cd	82.0 ±0.2 b
NPK 1500 ppm	85.1 ±1.8 a	82.9 ±2.5 bc	84.0 ±0.4 a
NPK 3000 ppm	82.1±1.1 bcd	80.7 ±1.4 cde	81.4 ±0.5 b
PA 2000 ppm + NPK 1500 ppm	85.3 ±0.7 a	81.9 ±0.7cd	83.6 ±1.1 a
PA 4000 ppm + NPK 3000 ppm	82.1 ±1.1 bcd	81.2 ±1.1 cd	81.6 ±0.5 b
Means of Varieties	83.0 ±0.7	81.3 ±1.3	

The treatments of the same letter do not differ significantly at the level of probability 5 percent.

Leaf Chlorophyll Content Index (CCI)

The results explain in Table (4) the variety Sara was superior to the variety Rizan in (CCI), as it recorded the highest rate of the trait amounted to (40.6), while the variety Rizan recorded the lowest rate of the trait amounted to (38.4), and this may be due to the effect of the content of the variety of chlorophyll by the interaction of genetic factors with environmental factors. This result is similar with Aryal et al. (2018) and Rekani et al. (2017).

In soaking treatments, all the soaking treatments were superior compare to the control treatment, as the NPK 1500 ppm treatment recorded the highest rate of the trait amounted to (41.3) and without significant difference from the treatments NPK 3000 ppm and PA 4000 ppm + NPK 3000 ppm. The reason for the increase in the (CCI) with the effect of soaking with the nanocomposite fertilizer NPK 1500 ppm may be attributed to its role in increasing the growth and cell division and consequently increasing the vegetative growth of the plant, which was reflected in the increase in the leaf origins and thus the increase in the content of chlorophyll in the leaves, In addition to the role of nitrogen in stimulating the production of gibberellins, which delays the aging of leaves by increasing the synthesis of chlorophyll and the formation of chloroplasts, which maintains the activity of leaves for a longer period and prevents their yellowing (Rop, et al., 2019). This result is in correspond with Al-Juthery et al. (2018) and Noaema^b et al. (2020).

It was observed when overlapping the varieties and soaking treatments the superiority of the interaction of Sara variety with the soaking treatments PA 2000 ppm (41.9) and NPK 1500 ppm (41.7) compared with the control treatment and without significant difference with the interaction of Sara variety with the soaking treatments PA 4000 ppm and NPK 3000 ppm, PA 2000 ppm + NPK 1500 ppm, PA 4000 ppm + NPK 3000 ppm and Rizan's variety overlapped with the soaking treatments NPK 1500 ppm, NPK 3000 ppm, PA 3000 ppm + NPK 3000 ppm.

Table (4): Effect of Varieties and Amino acids and Nanofertilizers on Chlorophyll Content Index (CCI) .

Amino acids and Nanofertilizers	Varieties		Means of Amino acids and Nanofertilizers
	Sara	Rizan	
Control	38.9 ±1.2 bcd	36.0 ±1.0 e	37.4 ±0.7 c
PA 2000 ppm	41.9 ±2.5 a	36.8 ±2.3 de	39.4 ±2.4 b
PA 4000 ppm	40.4 ±0.5 ab	37.5 ±1.1 cde	38.9 ±0.7 bc
NPK 1500 ppm	41.7 ±1.6 a	40.8 ±1.0 ab	41.3 ±1.3 a
NPK 3000 ppm	41.1 ±0.8 ab	39.7 ±0.6 abc	40.4 ±0.4 ab
PA 2000 ppm + NPK 1500 ppm	39.9 ±1.1 abc	38.6 ±0.3 bcd	39.3 ±0.7 b
PA 4000 ppm + NPK 3000 ppm	40.6 ±1.1 ab	39.5 ±1.0 abc	40.1 ±0.9 ab
Means of Varieties	40.6 ±0.4 a	38.4 ±0.6 b	

The treatments of the same letter do not differ significantly at the level of probability 5 percent.

Total Tillers Number.m⁻² (TTN)

Table (5) shows that Sara variety was significantly superior to Rizan variety in the trait (TTN), as it achieved the highest significant rate of the trait (266.0) tiller.m⁻², while Rizan achieved the lowest rate of the trait (221.1) tiller.m⁻², and the reason for the differences between rye wheat varieties in (TTN) back to the genotype variation for varieties. This result is similar with Feledyn-Szewczyk et al. (2020) and Noaema^a et al. (2020).

In the soaking treatments, all the soaking treatments were superior compare to the control treatment, as the NPK 1500 ppm soaking treatment achieved the highest significant rate of the trait (253.8) tiller.m⁻². The reason for the increase in the Total tillers number may be attributed to the fact that plants were treated with NPK nano fertilizer even in the case of low level, It helped to penetrate the tissues and increase the rate of absorption as a result of the small size of the nanomaterials, This led to stimulating plants in the increase of tillers(Abdel-Aziz, et al., 2016). This finding is in agreement with Kandil & Marie (2017) and Noaema^b et al. (2020).

Varieties overlap with soaking treatments explain that the interaction of Sara variety with the soaking treatment NPK 1500 ppm was significantly (275.3) tiller.m⁻² compared with the control treatment and with no difference from interaction Sara variety with the soaking treatment NPK 3000 ppm.

Table (5): Effect of Varieties and Amino acids and Nanofertilizers on Total Tillers Number.m⁻² .

Amino acids and Nanofertilizers	Varieties		Means of Amino acids and Nanofertilizers
	Sara	Rizan	
Control	256.0 ±3.1 d	214.0 ±4.6 h	235.0 ±6.1 d
PA 2000 ppm	266.0 ±2.6 bc	221.7 ±3.5 fg	243.8 ±2.3 c
PA 4000 ppm	260.3 ±2.1 cd	217.3 ±3.1 gh	238.8 ±1.9 d
NPK 1500 ppm	275.3 ±3.1 a	232.3 ±2.5 e	253.8 ±2.8 a
NPK 3000 ppm	271.3 ±2.1 ab	225.7 ±1.2 f	248.5 ±1.5 b
PA 2000 ppm + NPK 1500 ppm	268.3 ±2.1 b	222.7±1.2 fg	245.5 ±1.3 bc
PA 4000 ppm + NPK 3000 ppm	266.3 ±2.1 bc	221.3 ±0.6 fg	243.8 ±1.2 c
Means of Varieties	266.2 ±2.1 a	222.1±1.5 b	

The treatments of the same letter do not differ significantly at the level of probability 5 percent.

Number the Leaves.Tiller⁻¹ (NLS)

Table (6) shows that there were no significant differences between the two varieties in the trait (NLS), as the two varieties Sara and Rizan achieved average (4.9 and 4.7) leaf. tiller⁻¹, respectively, and perhaps the lack of difference between the two varieties is due to their genetic characteristic.

In the soaking treatments, all the soaking treatments were superior compare to the control treatment, as the NPK 1500 ppm soaking treatment achieved the highest significant mean for the trait, which reached (5.1) leaf. tiller⁻¹. The reason for its superiority may be attributed to its role in regulating the action of plant hormones, including auxins and cytokinins, which led to an increase in meristematic cell division and consequently an increase in Total tillers number (Table 5), Thus, increase the leaves.

It was noticed when the interaction between the varieties and the soaking treatments, the superiority of the interaction between the variety Sara and the soaking treatment NPK 1500 ppm, which amounted to (5.2) leaf.tiller⁻¹ compared with the control treatment and without significant difference with the interaction of Sara variety with the soaking treatments PA 2000 ppm and PA 2000 ppm + NPK 1500 ppm and PA 4000 ppm + NPK 3000 ppm and Rizan's variety overlapped with the soaking treatments NPK 1500 ppm and NPK 3000 ppm.

Table (6): Effect of Varieties and Amino acids and Nanofertilizers on Number. of Leaves.Tiller⁻¹ .

Amino acids and Nanofertilizers	Varieties		Means of Amino acids and Nanofertilizers
	Sara	Rizan	
Control	4.7 ±0.2 bcde	4.5 ±0.1 e	4.6 ±0.1 d
PA 2000 ppm	5.0 ±0.2 ab	4.6 ±0.2 de	4.8 ±0.2 bcd
PA 4000 ppm	4.8 ±0.2 bcde	4.6 ±0.2 e	4.7 ±0.1 cd
NPK 1500 ppm	5.2 ±0.1 a	5.0 ±0.2 ab	5.1 ±0.1 a
NPK 3000 ppm	4.9 ±0.1 bc	5.0 ±0.3 abc	4.9 ±0.1 b
PA 2000 ppm + NPK 1500 ppm	5.0 ±0.1 abc	4.8 ±0.1 bcd	4.9 ±0.1 b
PA 4000 ppm + NPK 3000 ppm	5.0 ±0.1 abc	4.7 ±0.1 cde	4.8 ±0.1 bc
Means of Varieties	4.9 ±0.1	4.7 ±0.1	

The treatments of the same letter do not differ significantly at the level of probability 5 percent.

Leaf Area (cm²) (LA)

Table (7) indicate that the variety Sara was significantly superior to the variety Rizan in the trait (LA), as it recorded the highest rate of the trait amounted to (27578.0) cm², while the variety Rizan recorded the lowest rate of the trait reached (21170.2) cm², This may be due to his superiority in (NLT) (Table 6). This finding is in agreement with Burhan & Hassan (2019) and Noaema^a et al. (2020).

All the soaking treatments were superior compare to the control treatment, as the NPK 1500 ppm soaking treatment recorded the highest significant mean for the trait, which amounted to (29387.9) cm². The increase in the leaf area of the plant due to the increase in the number of leaves. . tiller⁻¹(Table 6), or perhaps the reason is due to the nanocomposite fertilizer in increasing (LA) to the fact that its cycle continues from the seedling stage to somewhat later stages of the plant's life, which was reflected in the increase in the leaf area of the plant as a result of the depletion of the fertilizer particles into the plant cells. This finding is in agreement with Burhan & Hassan (2019).

The interaction between varieties and soaking treatments significantly affected in this trait, as the interaction of Sara variety with the soaking treatment NPK 1500 ppm was significant by record it the high rate of (LA) reached (33459.0) cm².

Table(7):Effect of Varieties and Amino acids and Nanofertilizers on Leaf Area (cm²) .

Amino acids and Nanofertilizers	Varieties		Means of Amino acids and Nanofertilizers
	Sara	Rizan	
Control	23104.0±824.1 de	18011.0 ±1077.5 g	20557.6 ±883.6 e
PA 2000 ppm	27059.0±1273.3 bc	19655.0 ±693.0 fg	23357.4 ±722.4 d
PA 4000 ppm	24695.0±2622.2 cde	18518.0 ±1668.4 g	21606.6 ±1111.9 e
NPK 1500 ppm	33459.0 ±777.3 a	25316.0±2434.9 cd	29387.9 ±1285.8 a
NPK 3000 ppm	29095.0 ±368.4 b	24015.0±1203.8 de	26555.1 ±713.4 b
PA 2000 ppm + NPK 1500 ppm	28488.0 ±1400.7 b	22126.0 ±1456.5 ef	25306.6 ±1144.4bc
PA 4000 ppm + NPK 3000 ppm	27146.0±1485.6 bc	20550.0 ±1002.3 fg	23847.8 ±1174.8cd
Means of Varieties	27578.0 ±364.9 a	21170.2 ±714.6 b	

The treatments of the same letter do not differ significantly at the level of probability 5 percent.

Leaf Area Index (LAI)

Table (8) shows that the variety Sara was significantly superior to the variety Rizan in the trait (LAI) by giving it the highest average of the trait amounted to (2.8), while the variety Rizan gave the lowest average of the trait amounted to (2.1) , The reason for the increase in the (LAI) in the variety Sara attributed to the increase in the (LA) for it (Table 7).

All soaking treatments were superior compare to the control treatment, as the NPK 1500 ppm soaking treatment gave the highest significant mean for the trait that was (2.9), The reason for the superiority of the nanocomposite fertilizer NPK 1500 ppm in this trait may be attributed to its superiority in the two characteristics of the (NLS) and (LA) (Table 6 and 7).

The interaction between the varieties and the soaking treatments indicate to superiority of Sara variety with the soaking treatment NPK 1500 ppm by giving it the highest rate of the trait (3.3) compared with the rest of the treatments.

Table (8):Effect of Varieties and Amino acids and Nanofertilizers on Leaf Area Index.

Amino acids and Nanofertilizers	Varieties		Means of Amino acids and Nanofertilizers
	Sara	Rizan	
Control	2.3 ±0.1 de	1.8 ±0.1 g	2.1 ±0.1 e
PA 2000 ppm	2.7 ±0.1 bc	2.0 ±0.1 fg	2.3 ±0.1 d

PA 4000 ppm	2.5±0.3 cde	1.9 ±0.2 g	2.2 ±0.2 e
NPK 1500 ppm	3.3 ± 0.1a	2.5 ±0.2 cd	2.9 ±0.1 a
NPK 3000 ppm	2.9 ±0.0 b	2.4 ±0.1de	2.7 ±0.1 b
PA 2000 ppm + NPK 1500 ppm	2.8 ±0.1 b	2.2 ±0.1 ef	2.5 ±0.1 bc
PA 4000 ppm + NPK 3000 ppm	2.7 ±0.1 bc	2.1 ±0.1 fg	2.4 ±0.1 cd
Means of Varieties	2.8 ±0.0 a	2.1 ±0.1 b	

The treatments of the same letter do not differ significantly at the level of probability 5 percent.

Conclusions

- Sara variety was superior in all of the growth characteristics
- The use of nano-fertilizer and amino acids (especially at low levels of them) led to an increase in all of the growth characteristics of triticale plants.

ORCID:

R.F.Ahmed: <https://orcid.org/0000-0002-1762-1386>

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تأثير الأحماض الأمينية والأسمدة النانوية في صفات نمو صنفين من القمح الشيلمي

³اري سليمان ياسين ²امجد ذنون خليل ¹ريان فاضل احمد

قسم المحاصيل الحقلية، كلية الزراعة والغابات، جامعة الموصل، العراق¹

قسم الإنتاج النباتي ، مديرية زراعة نينوى ، وزارة الزراعة ، العراق .²

مديرية البحوث والإرشاد ، ديوان وزارة الزراعة والموارد المائية ، أربيل ، العراق .³

نفذت هذه الدراسة في الموسم الزراعي الشتوي 2021- 2022 في موقع توكيف شمال مدينة الموصل : المستخلص لدراسة تأثير صنفين من القمح الشيلمي (ساره وريزان) وسبعة معاملات لحبوب الصنفين بمركب الأحماض الأمينية أحماض أمينية ، 1500 ، 4000 ppm ، 2000 ، 0 (النانوي بالتراكيز N₂₀P₂₀K₂₀البولي امين والسماذ المركب أحماض أمينية + ppm سماد نانوي ، 4000 ppm أحماض أمينية + 1500 ppm سماد نانوي ، 2000 ppm سماد نانوي) في صفات النمو تحت الظروف الديمية . نفذت التجربة حقليا وفق تصميم القطاعات العشوائية 3000ppm (بنظام الألواح المنشقة بثلاث مكررات. أشارت النتائج إلى تفوق الصنف سارة معنويا في مؤشر R.C.B.D الكاملة)² والمساحة الورقية (27578.0) سم² (266.2) شطء .م²محتوى الكلوروفيل في الأوراق (40.6) وعدد الأشرطة الكلوية.م في جميع الصفات المدروسة . كما سجل 1500 ppm NPK ودليل المساحة الورقية (2.8) . تفوقت معاملة النقع اعلى معدل في معظم الصفات المدروسة 1500 ppm NPK والتداخل الثنائي بين الصنف سارة مع معاملة النقع الكلمات المفتاحية: السماد النانوي ، الأحماض الأمينية ، الأصناف ، صفات النمو