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RESPONSE OF COMMON BEAN TO RHIZOBIUM INONCULATION AND CHELATING NANO NPK FERTIGATION UNDER DRIP IRRIGATION

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ABSTRACT

Field experiment conducted at winter season 2022-2023 on clay sandy soil in Al-Diwanyia. The experiment was design as Randomized Complete Block Design with three replications arranged for split-pilot design, the main treatment included two groups inoculation and non-inoculation within each group four levels of Nano NPK (0, 1, 2, 3) g.L^{-1} added in two steps (20 and 50) day of plant growth. A sample was taken of soil (30 cm depth) to analysis it and to know its physical and chemical properties. Table (1) *phouslus voulgares* L were sowing at a rate 25 kg.ha^{-1} [40 cm between plants (30 cm depth)] at 1/9, after 7 months a sample was taken to measure. The results showed all factors and interactions were significant effect and increased all growth features (plant content of protein, carbohydrates and fats, Dibenzyloxynitrobenzene, Benzoylpentanoic acid, Valylvaline, Grain yield) max values respectively (30.24, 58, 2.637)%, 3.09 2.92, 1.89, 6.86 T.ha^{-1}) come from interaction of Rhizobium inoculation and 3 g.l^{-1} while the lowest values respectively [(22.41, 52.26, 2.19)%, 0.02, 0.02, 0.02, 4.39 T.ha^{-1}] come from interaction of non-Rhizobium inoculation and 0 g.L^{-1} Nano NPK level.

Keywords: Inoculation, Rhizobium, Fertigation, Common bean, Nano NPK

INTRODUCTION

Common bean (*phouslus voulgares* L.) main sources of protein [18], also one of the medicinal plants [15,9] also Bio remedater because ability to remove heavy metals like Cadmium from soil [7]. Common bean contained 26-30% protein [10] and 50-60%- carbohydrate [17] and 2- 2.6% fat [8]. Seeds of common bean (*P. vulgaries* L.) inoculated with *Rhizobium phaseoli* L. so as to stimulate bio fertilizer [6] and increased resistance to biotic and abiotic stresses and increased resistance to salinity and drought because ability in supplying legume plants needing [1]. Foliar spray 200 ppm Nano NPK increased grain yield of wheat [5]. Foliar spray of 100ppm NPK Nano fertilizers increased seed yield of Chickpea [20] fertigation 2g.l^{-1} Nano fertilizer increased growth of wheat by increased nutrient use offence also ecofriendly because slow release [3] Foliar spray of 75 g.l^{-1} Nano

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NPK increased harvest index of wheat [12]. Uses of Nanoparticles Foliar spray of Nano NPK by five levels (0, 30, 60, 90, 120) mg l^{-1} on broad been (Vcia fava). The result shows significant influence between treatment the best value at the (120 mg l^{-1}) in plant height, number of branch plant $^{-1}$, number of leaves plant -1, leaves chlorophyll content %, dry matter in leaves. were recorded from 120mg. l^{-1} [5]. This study aimed to know effects of Rhizobium inoculation and Nano NPK fertigation on Common bean.

MATERIALS AND METHODS

The area of field 253m^2 is divided into two main plots 126.5 m^2 and subplot area 6m^2 one meter separated them (main plot and subplot) within their four levels of fertigation Chelating Nano NPK which suitable in fertigation because slow released and inapplicable to foliar spray. Treatments in three replications for each subplot. All treatment irrigated by drip irrigation connected with four separated tanks (1000 L capacity) for each treatment (Timer 40 $L.h^{-1}$) All treatments fertilized with 20 kg. ha^{-1} Urea 47% nitrogen to stimulate *nif* H gene it responsible on nitrogenase [21]. It was added 10 ml of methanol (100%) on seeds powder and mixing at 10 min. Then store at 6h in dark place then filtered 4.5µ and it was added 1ml hexane (100%) then analysis by GC-Mass. Analysis of fats by dissolved 10 g of seeds powder with 10 ml Hexane 100%and inter to Soxhlet. While analysis of carbohydrates depend on Herbert et al. [13] *Rhizobium phaseoli* L culture's prepare from crushed sterile old root nodule with one drop of distal water then incubated at 30ºC to 3-7 days [16]. Protein percent measure by multiplying nitrogen percent * 6.25 [2].

Table1: Analysis of soil before planting

Analysis of soil before planting		
Value	**Unite**	**Properties**
7.36	------	Soil PH
9.50	(µS/cm)	Electrical conductivity
4.56	g.kg^{-1} of soil	Organic matter
73	mg.kg^{-1} of soil	A voluble nitrogen
43.5		A voluble phosphor
53		A voluble potassium
306.7	g.kg^{-1} of soil	Sand
98.5		Silt
594.8		Clay
	Sandy – clay soil	Texture

RESULTS AND DISSCUSSION

Protein percent %

Table 2 shows significant effect of inoculation on protein percent% max value (28.723%) of Common bean (*P. vulgaries* L.) because increased number of root nodules which responsible on nitrogen fixation this accepted with Begon et al. [6], also showed significant effect of Nano NPK fertilizers on protein percent of Common bean (*P. vulgaries* L.), max value (28.263%) in treatment 3 g.l^{-1} because of increased Nano element through plasma membrane it is very small size and increased activity of enzymes which responsible on protein synthesis this consistent with Heba et al. [12]. Also result shows significant effect of interaction of Nano NPK and inoculation max value (30.247%) in inoculation and 3 g.$^{-1}$

because of roles of Nano NPK as stimulator to photosynthesis and nitrogenase enzymes this accepted with Bayan et al. [14].

1-Carbohydrates percent %

Table 2: Effect of inoculation with *Rhizobium* and Nano NPK on protein % in common bean

Rates inocu. Effect	Levels of Nano NPK gram. l-1				Inoculation with Rhizobium
	3	2	1	0	
28.793	30.247	29,.25	28.317	27.357	Inoculated seeds
24.09	26.28	24.28	23.39	22.41	Non Inoculated seeds
	28..263	26.765	25.853	24..883	Rates of Nano NPK effect
LSD A= 0.6	LSD a*b= 0.625			LSD b= 0.451	

Table 3 shows significant effect of inoculation on carbohydrates percent % max value (58%) of Common bean (*P. vulgaries* L.) because increased precursor of photosynthesis enzymes and root nodules provided all types of amino acids depend on type of organic acids come from Krebs cycles this result consistent with Begon et al. [6[, also result showed significant effect of Nano NPK fertilizers on carbohydrates percent of Common bean (*P. vulgaries* L..) max value (57.768%) in treatment 3 g.l^{-1} because of increased Nano element passed through plasma membrane it is very small size and increased activity of enzymes which responsible on carbohydrates synthesis this consistent with Al-Burki et al. [1]. Also showed significant effect of interaction of Nano NPK and inoculation max value (60.1837%) in inoculation and 3 g.$^{-1}$ because of roles of Nano NPK as stimulator to photosynthesis and nitrogenase enzymes this consistent with Shah et al. [19].

Table 3: Effect of inoculation with Rhizobium and Nano NPK On Carbohydrates% in common bean

Rates inocu. effect	Levels of Nano NPK gram · l^{-1}				Inoculation with Rhizobium
	3	2	1	0	
58	60.183	58.34	57.277	56.2	Inoculated seeds
53.788	55.353	54.283	53.253	52.26	Non Inoculated seeds
	57.768	56.312	55.265	54.23	Rates of Nano NPK effect
LSD = 0.987	LSD a*b= 0.753			LSD b= 0.32	

2-Fats percent %

Table 4 shows significant effect of inoculation on fats percent% max value(2.402%) of Common bean (*P. vulgaries* L.) because increased precursor of fats synthesis enzymes root nodules provided all types of amino acids depend on type of organic acids come from Krebs cycle consistent with Heba et al. [12], also result showed significant effect of Nano NPK fertilizers on Fats percent of Common bean (P. vulgaries L..), max value (2.433%) in treatment 3 g.l^{-1} because of increased Nano element passed through plasma membrane it is very small size and increased activity of enzymes which responsible on Fats synthesis this consistent with Al-Burki et al. [1]. Also result showed significant effect of interaction of Nano NPK and inoculation max value (2.637%) in inoculation and

3 g.$^{-1}$ because of roles of Nano NPK as stimulator to Fats synthesis and nitrogenase enzymes this consistent with Shah et al. [19].

Table 4: Effect of inoculation with Rhizobium and Nano NPK on Fats % in common bean

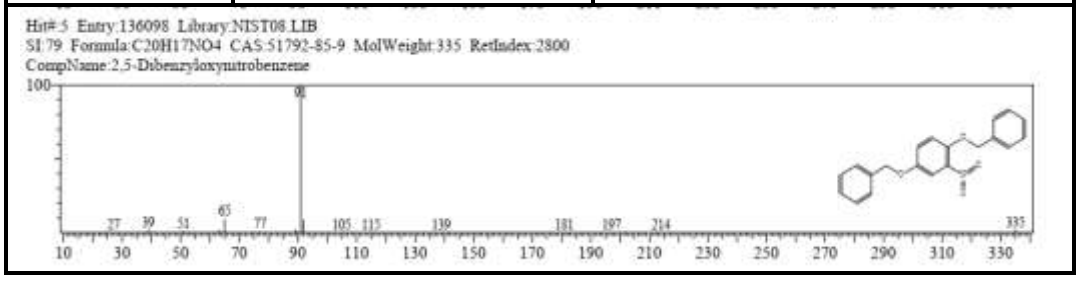
Rates inocu. effect	Levels of Nano NPK gram. l-1				Inoculation with Rhizobium
	3	2	1	0	
2.402	2.637	2,.337	2.33	2.307	Inoculated seeds
2.216	2.23	2.213	2.23	2.19	Non Inoculated seeds
	2..433	2.275	2.28	2..248	Rates of Nano NPK effect
LSD a=0.073.	LSD a*b= 0.146			LSD b= 0.103	

3-2,3 Dibezyloxynitrobenzene

Table 5 shows significant effect of inoculation on 2,3 Dibezyloxynitrobenzene max value (2.25) of Common bean (P. vulgaries L.) because increased precursor of active substances synthesis enzymes root nodules provided all types of amino acids depend on type of organic acids come from Krebs cycle this consistent with Begon et al. [6], also showed significant effect of Nano NPK fertilizers on 2,3 Dibezyloxynitrobenzene of Common bean (P. vulgaries L..), max value(1.96) in treatment 3 g.l-1 because of increased Nano element passed through plasma membrane it is very small size and increased activity of enzymes which responsible on active substances synthesis this consistent with Al-Burki et al. [1]. Also showed significant effect of interaction of Nano NPK and inoculation max value (3.09) in inoculation and 3 g-1 because of roles of Nano NPK as stimulator to active substances synthesis and nitrogenase enzymes this consistent with Shah et al. [19].

Table 5: Effect of inoculation with Rhizobium and Nano NPK on Dibezyloxynitrobenzene in common bean

Rates inocu. effect	Levels of Nano NPK gram. l^{-1}				Inoculation with Rhizobium
	3	2	1	0	
2.25	3.09	2.97	2.92	0.02	Inoculated seeds
2.08	2.84	2.81	2.66	0.02	Non Inoculated seeds
	2.96	2.89	2.79	0.02	Rates of Nano NPK effect
LSD = 0.11	LSD a*b= 0.1			LSD b= 0.07	



4-Benzoylpentanoic acid

Table 6 shows significant effect of inoculation on 5-Benzoylpentanoic acid max value (2.12) of Common bean (P. vulgaries L.) because increased precursor of active substances synthesis enzymes root nodules supplied all types of amino

acids depend on type of organic acids come from Krebs cycle this consistent with Begon et al. [6], also showed significant effect of Nano NPK fertilizers on 5-Benzoylpentanoic acid of Common bean (P. vulgaries L.), max value (2.78) in treatment 3 g.l^{-1} because of increased Nano element passed through plasma membrane it is very small size and increased activity of enzymes which responsible on active substances synthesis this consistent with Al-Burki et al. [1]. Also showed significant effect of interaction of Nano NPK and inoculation on 5-Benzoylpentanoic acid max value (2.92) in inoculation and 3 g.$^{-1}$ because of roles of Nano NPK as stimulator to active substances synthesis and nitrogenase enzymes this consistent with Shah et al. [19].

5-Valylvaline

Table 6: Effect of inoculation with Rhizobium and Nano NPK on Benzoylpentanoic acid in common bean

Rates inocu. effect	Levels of Nano NPK gram. l-1				Inoculation with Rhizobium
	3	2	1	0	
2.12	2.92	2.81	2.71	0.02	Inoculated seeds
1.89	2.64	2.54	2.41	0.02	Non Inoculated seeds
	2.78	2.66	2.56	0.02	Rates of Nano NPK effect
LSD = 0.049	LSD a*b= 0.0.064			LSD b= 0.0.049	

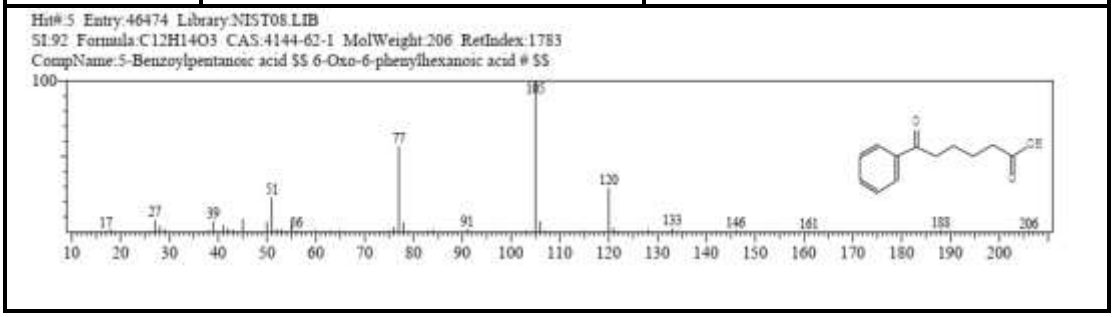
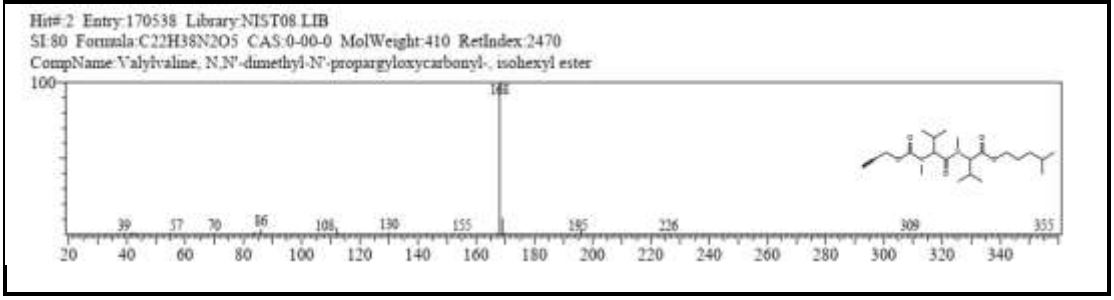


Table 7 shows significant effect of inoculation on Valylvaline max value(1.39) of Common bean (P. vulgaries L.) because increased precursor of active substances synthesis enzymes nodules provided all types of amino acids depend on type of organic acids come from Krebs cycle this consistent with Heba et al. [12], also result showed significant effect of Nano NPK fertilizers on Valylvaline acid of Common bean (P. vulgaries L..), max value (1.84) in treatment 3 g.l^{-1} because of increased Nano element passed through plasma membrane it is very small size and increased activity of enzymes which responsible on active substances synthesis this consistent with Al-Burki et al. [1]. Also result showed significant effect of interaction of Nano NPK and inoculation on Valylvaline max value (1.89) in inoculation and 3 g.$^{-1}$ because of roles of Nano NPK as stimulator to active substances synthesis and nitrogenase enzymes this consistent with Khalif and Mohammed [14].

Table 7: effect of inoculation with Rhizobium and Nano NPK on Valylvaline in common bean

Rates inocu. effect	Levels of Nano NPK gram . l-1				Inoculation with Rhizobium
	3	2	1	0	
1.39	1.89	1.85	1.82	0.02	Inoculated seeds
1.33	1.79	1.8	1.74	0.02	Non Inoculated seeds
	1.84	1.82	1.78	0.02	Rates of Nano NPK effect
LSD = 0.047	LSD a*b= 0.043			LSD b= 0.029	



6-Grain yield (Ton. ha^{-1})

Table 8 shows significant effect of inoculation on grain yield max value (6.274) Ton. ha^{-1} of Common bean (P. vulgaries L.) because increased precursor of active substances synthesis enzymes root nodules provided all types of amino acids depend on type of organic acids come from Krebs cycle this consistent with Begon et al. [6], also result showed significant effect of Nano NPK fertilizers on grain yield of Common bean (P. vulgaries L..), max value (6.12) Ton. ha^{-1} in treatment 3 g.l^{-1} because of increased Nano element passed through plasma membrane it is very small size and increased activity of enzymes which responsible on active substances synthesis this consistent with Al-Burki et al. [1]. Also result showed significant effect of interaction of Nano NPK and inoculation consistent on Grain yield max value (6.86) Ton. ha^{-1} in inoculation and 3 g^{-1} because of roles of Nano NPK as stimulator to active substances synthesis and nitrogenase enzymes this consistent with Barhan and Hassan [5] Hayyawi and Qusay [11].

Table 8: Effect of inoculation with Rhizobium and Nano NPK on grain yield Ton ha-1 in common bean

Rates inocu. effect	Levels of Nano NPK gram. l-1				Rhizobium Inoculation
	3	2	1	0	
6.274	6.86	6,.45	6.073	5.71	Inoculated seeds
4.866	5.38	5.02	4.66	4.39	Non Inoculated seeds
LSD a= 0.048	6.12	5.738	5.37	5..053	Rates of Nano NPK effect
	LSD a*b= 0.044			LSD b= 0.03	

REFERENCES

1- Al-Burki, H. A. H. and A. H. S. A. Saadon (2021). Effect of bio-fertilizer and Nano elements on growth and yield of Phaseolus vulgaries L. varieties. Plant archives 21(1):191-1194.

2- AOAC (2000). Official of Analysis of AOAC International 17th ed. Washington DC, 5-15.

3-Astaneh, N.; B. faroud; Z. Mahdi; A. Bahram and B. Abdollah (2021): Nano – fertilizer prevents pollution and improves physiological traits of Wheat grown under drought stress conditions. A GROPECUARIA 12 (1).

4-Aziz, B. R. and D. B. Zarar (2021): Effect of Foliar application of Nano NPK fertilizer on growth and yield of Broad bean (Vicia faba L.) zanco Journal of pure and applied sciences

5-Barhan, M. G. and S. A. AL-Hassen (2019): Impact of Nano NPK fertilizer between productivity and quality and flage leaf of some bread wheat verities Iraqi J. Of Agric. Sci. Vol50 (special issue pp1-7.

6-Begon, M. F.; M.G. Ahmed and S. Rebeks (2021): Impact of Rhizobium and Ferrous A. biofertilizer on agronomical performance of lentil (BAR) Master -6) in Bangladesh. archives of Agriculture and Environmental Science, 6(2):114-120.

7-Burd, G. I.; G.D. Dixon and B. R. Glick (2000): Plant growth promoting bacteria that decrease heavy metal toxicity in plants. J. of Micro., 46: 237-245.

8-Celmeli T.; H. Sari; H. Canci; D. Sari; A. Adak; T. Eker; C. Toker (2018): The nutritional content of common bean (Phaseolus vulgaris L.) landraces in comparison to modern varieties. Agronomy, 8(166).

9-Duke, J. A.; J. B. Marry and K.D. Peggy (2002): Handbook of Medicinal Herbs second edution

10-Hayat, I.; A. Ahmad; T. Masud; A. Ahmed and S. Bashir (2014): Nutritional and health perspectives of beans (Phaseolus vulgaris L.): An overview. Crit. Rev. Food Sci. Nutr., 54:580–592.

11-Hayyawi, W. A.; G. Al-juthery and M. N. Al- Shami (2019): The Effect of Fertigation with Nano NPK Fertilizers on Some Parameter of Growth and yield of potato (Solanum tuberosum L.) QJAS Al-Qadisiyah Journal For Agriculture Sciences 9(2):225-232.

12-Heba, M. M.; A-A. Aziz; M. I.Soliimaan; A. A. Al Saoud and AA, G. El-Sherbeny (2021): Waste-Derived NPK Nano fertilizer Enhances Growth and Productivity of Capsicum annuum L

13-Herbert, D.; P. J. Philips and R. E. Strange (1971). Determination of total carbohydrates. In: Norris, J. R. and D. W. Robbins (eds): Methods in Microbiology. Acad. press. London and New York.USA

14-Khalif, N. S. and N. H. Mohammed (2018): The effect of chitosan-PMAA-NPK Nano fertilizer on Pisum sativum plants 3 Biotech 8:93.

15-Lyanne RodríguezDiego MendezHector MontecinoBasilio CarrascoBarbara ArevaloIván Palomo and Eduardo Fuentes (2022): Role of Phaseolus vulgaris L. in the Prevention of Cardiovascular Diseases—Cardioprotective Potential of Bioactive Compounds J. Plants 11(2) .

16-Mensoh, J. K.; F.Esumeh, M. Iyamu and C. Omoifa (2006): Effects of Different Salt Concentrations and pH on Growth of Rhizobium sp. a Cowpea-Rhizobium Association American-Eurasian J. Agric. and Environ. Sci. 1(3): 198-200

17-Ovando - Martínez, M.; L. A. Bello-Pérez; K. Whitney; P. Osorio-Díaz and S. Simsek (2011): Starch characteristics of bean (Phaseolus vulgaris L.) grown in different localities. Carbohydr. Polym., (85): 54–64

18-Pereira, H. S.; R. C. Alvares; L. C. Melo; A. F. Costa and H. W. L. De Carvalho (2017): Culinary and nutritional quality of common bean lines with Carioca grain type and interaction with environments. Rev. Ceres, 64:159–166.

19-Shah, A. A.; S. Aslam; M. Akbar; A. Ahmed; W. U. Khan; N. A. Yasin; B. Ali; M. Rizwan and S. Ali (2021): Combined effect of Bacillus fortis IAGS 223 and Zinc oxide Nanoparticles to alleviate cadmium phytotoxity in Cucumis melo plant physiol. Biochem. Vol. 158.

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20-Talebi, R. and K. Homayoun (2016): Foliar application of Fe, Zn and NPK Nano fertilizers on seed yield and morphological traits in Chickpea under rainfed condition J. of Research in Ecology 4 (2):21-228.

21-Xuan, X.; Ma. Chunmei; D. Shoukun; X. Yao and Zhenping G. (2017): Effects of nitrogen concentrations on nodulation and nitrogenase activity in dual root systems of soybean plants. Soil Science plant Nutrition 63(5):470-482.

استجابة نبات الفاصولياء البيضاء للتلقيح بالرايزوبيوم وسماد NPK النانوي المخلبي بالرسمده تحت الري بالتنقيط

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الملخص

اجريت هذهِ التجربة الحقلية في الموسم الشتوي للعام **2022–2023** بتربة طينية رملية في محافظة الديوانية. صممت التجربة بالقطاعات العشوائية الكاملة **(RCBD)** وبثلاثة مكررات بتنظيم القطع المنشقة شملت التلقيح يالرايزوبيوم وغير التلقيح الوحدتين الرئيسيتين وبداخل كل مجموعة اربعة مستويات **NPK** النانوي (**0**، **1**، **2**، **3**) غم.لتر**–1**، بدفعتين (**20** و**50**) يوماً من عمر النبات اخذت عينة من التربة قبل الزراعة من عمق **30** سم لتحليلها لمعرفة خواصها الفيزيائية والكيميائية، زرعت بذور الفاصولياء بمعدل بذار **25**كغم. هـ$^{-1}$ (**40** سم المسافة بين النباتات بتاريخ **9/1** وبعمق زراعة **3**سم، وبعد **7** أشهر من الزراعة اخذت العينات لإجراء القياسات التي شملت الصفات المدروسة (نسبة البروتين ونسبة الكربوهيدرات وبنسبة الدهون)% وثنائي بنزين اوكسي نتروبنزين وبنزيلوكسي بنتونك اسيد وفالي فالين وحاصل الحبوب طن. هـ$^{-1}$) فكانت اعلى القيم على التوالي (**30.24**، **58**، **2.637**) **3.09%** ، **2.92** ، **1.89** ، **6.86** طن. هـ$^{-1}$ الناتجة من تداخل التلقيح بالرايزوبيوم مع **NPK** النانوي **3** غم.لتر$^{-1}$ بينما اوطأ القيم على التوالي (**22.41** و **52.26** ، **2.19**)% **0.02** ، **0.02** ، **0.02** **4.39** طن. هـ$^{-1}$) ناتجة من تداخل عدم التلقيح مع مستوى **NPK** النانوي **0**غم.لتر$^{-1}$.

الكلمات الدالة: التلقيح، الرايزوبيوم، رسمدة، الفاصولياء، NPK النانوي.

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