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The Effect of Complete DAP And Nano Silicon Fertilizer on the Activity of the Enzyme Urease in Soil Cultivated with Rice (*Oryzae Sativa*)

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Abstract

With the aim of studying the effect of adding different sources of DAP fertilizers and Complete nano silicon and nano fertilizers on the activity of the urease enzyme in the rhizosphere and outside it, and for the rice plant, cultivars Amber 33.The experiment was conducted in one of the rice fields located in the district of Ghamas / Al-Diwaniyah province- Iraq in the summer season of 2019 in a Loam Clay textures, and then the rice seed was planted, Amber 33, the total area of the field was 350 square meters and the experiment treatments were two levels of DAP fertilizer (Control, M-DAP, O-DAP and O-DAP High K) is (0,240) kg and two levels of nano silicon fertilizer (0,2) ml.L $^{-1}$ and two levels of nano- Complete fertilizer (0, 2) g.L $^{-1}$ In addition to the interactions between the treatments, the experiment was conducted using a Randomized Complete e Block Design (RCBD) with three replicates for each treatment. The averages were compared according to the LSD test at a probability level (0.05). Then the efficacy of the urease enzyme in the rhizosphere soil and outside it was estimated after 35, 65 and 95 from cultivation. The results of laboratory tests showed that the treatment of organic DAP fertilizer O-DAP High K compared to the other two types of DAP fertilizer was the highest of the significant averages of the effectiveness of the urease enzyme in the rhizosphere after 95 days of cultivation amounted to (91.7) µg $N^-NH_4{}^+ g^{-1}$ soil2h^{-1}. The organic DAP fertilizer O-DAP achieved a significantly excelled on the other two types of DAP fertilizer in recording the highest significant averages of the activity of the urease enzyme in the rhizosphere and outside the rhizosphere after (35, 65) days of cultivation, reaching (50.28 and 46.43, 74.69 and 69.5) µg $N^-NH_4{}^+ g^{-1}$ soil2h^{-1} respectively. Nano silicon fertilizer NS achieved the highest average for measuring the activity of the urease enzyme after 65 days of cultivation in and outside the rhizosphere soil (68.48 and 60.9) µg $N^-NH_4{}^+ g^{-1}$ soil2h^{-1} While 35 days after cultivation , an average of (48.44) µg $N^-NH_4{}^+ g^{-1}$ soil2h^{-1}) was recorded in the rhizosphere soil. The complete e nano fertilizes NC achieved the highest average in measuring the activity of the urease enzyme after 95 days of cultivation in the rhizosphere and outside it reached (93.4 and 86.1) µg $N^-NH_4{}^+ g^{-1}$ soil2h^{-1}, while the average effectiveness was after 35 and 65 days of cultivation in and outside the rhizosphere soil (48.50 and 45.09) and (70.96 and 64.4) µg $N^-NH_4{}^+ g^{-1}$ soil2h^{-1}.The triple interaction treatment between (DAP, NS and NC) gave the highest average activity of the urease enzyme after 95 days of cultivation in the rhizosphere and outside it, the treatment (O-DAP HighK + NS + NC) gave the highest average of (103.5 and 92.3) µg $N^-NH_4{}^+ g^{-1}$ soil2h^{-1}, while the addition of (O-DAP + + NS Cont NC) recorded the highest average of 55.19 µg $N^-NH_4{}^+ g^{-1}$ soil2h^{-1} in the rhizosphere after 35 days of cultivation, as well as O-DAP +. NS + NC is the highest average (85.95 and 79.1) µg $N^-NH_4{}^+ g^{-1}$ soil2h^{-1} in and out of the rhizosphere after 65 days of cultivation.

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Introduction

The urease enzyme is widespread in nature, where it is produced by various types of microorganisms and is found in the soil in the form of exogenous enzymes that represent most of the soil enzymes, between (Andrews et al. 1989). Increasing the level of humidity reduces the activity of microbes, limits their reproduction, reduces gas exchange in the soil, and anaerobic conditions arise, thus reducing the metabolism of aerobic microbes, and that the enzymes in the soil are of microbial origin and hence the humidity affects the enzymatic activity in the soil (García-Ruiz et al., 2009) .The results of (Al-Taweel, 2016), which showed the significantly excelled in the effectiveness of the urease enzyme for soils with Slit clay on loamy sand texture in the rhizosphere and the region outside the rhizosphere alike,(Al-Jabri, 2010) found that the effectiveness of the enzyme urease differed according to the different moisture levels when used for three levels of moisture (half the field capacity, field capacity and saturation) and seven soils with different characteristics and the agricultural condition of soils in southern Iraq, where the submerged marsh soils gave the highest efficacy of the urease enzyme under conditions Saturation. Where he explained (Aswathy and Jose, 2013), In their study of the rhizosphere of the rice plant and outside it, when treating the soil with levels of compost, they found an increase in the activity of the urease enzyme in the rhizosphere of the plant compared to an area outside the root perimeter, thus leading to a significant increase in the activity of the urease enzyme in the rhizosphere and outside of the rice plant.Rice differs from most crops in that it is usually grown in submerged soils, which leads to areas of oxidation and reduction in which the oxygen is deficient in the root zone of the rice that chooses a physiological pattern defined by a group of microorganisms either aerobic, anaerobic, or selective self-metabolism (Brune et al., 2011). 2000).The most important thing is the interaction of the roots of the rice plant in the rhizosphere with the micro-organisms, and as a result of that interaction many important secretions are released, whether from the roots themselves or from the micro-organisms in the root area, and among these secretions are enzymes, including the enzyme urease, which works to prepare the important nitrogen images for the plant (Bais et al., 2006). In a study of the effect of nanofertilizers on the revitalization of micro-soil and enzymes, it was shown that the addition of NPK nanofertilizer ground ,foliar and organic manure increased biomass and increased the effectiveness of soil enzymes base phosphatase and urease (Nibin et al., 2019). The results of (Wang et al., 2011) showed that the treatment of rice plant Oryza sativa with nanoparticles led to a significant increase in growth indicators and plant content of nitrogen, phosphorus and potassium compared to untreated plants.In a study by (Shaaban et al., 2013) on the effect of organic fertilizer and organic humic acids and their effect on the rice plant, it was found that the addition increases the yield of the rice plant. Humic acid works in soils poor in organic matter and alkaline soils to improve the chemical and physical properties of soils and increase Biomass significantly and provide nutrients to the plant (Muter et al., 2015; Ehsan et al., 2016). The results of a study (Al-Khuzai and Juthery, 2020) on rice plants showed the excelled of the combination of DAP fertilizer with nano-silicon, which led to increases in the amounts of total nitrogen absorbed by plants by 96.54% compared to 38.28.Also, the results of (Abu Tabikha, 2019) on yellow corn plant showed an increase in the activity of the enzyme urease in the periphery and a decrease outside the periphery for all the treatments and periods of the study.

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Materials and Methods

The experiment was conducted in one of the fields located in Ghamas sub-district / Al-Qadisiyah province, which reached an area of 360 square meters during the summer season of 2019 in soil, and some of its chemical, physical and biological properties are explained in Table (1), In order to study the effect of DAP fertilizers and nano silicon and complete e nanofertilizers on the activity of the urease enzyme in the rhizosphere and outside of the rice plant cultivars Amber 33.

Table (1) Some physical, chemical and biological traits of the study soil

Traits		**values**	**units**	
Ph		7.53	----	**(Black $_b$, 1965)**
$EC_{1:1}$		4.96	dsm^{-1}	
Negative and positive dissolved ions	Ca^{+2}	30.0	$Cmol_cL^{-1}$	**(Black $_a$,1965)**
	Mg^{+2}	13.8		
	Na^{+1}	8.12		
	K^{+1}	4.30		
	Cl^{-1}	24.09		
	HCO_3^-	2.7		
	SO_4^{-2}	19.12		
	CO_3^{-2}	Nill		
$CaCO_3$		32.87	gkg^{-1}soil	**(Black$_b$, 1965)**
Organic matter (O.M)		6.9		
CEC		27.76	$Cmol_ckg^{-1}$ soil	**(Papanicolaou , 1976)**
availability nitrogen		23	$mgkg^{-1}$soil	**(Page , 1982)**
availability phosphorous		10.25		
availability Potassium		93.3		
Soil separators	Sand	308	gkg^{-1}soil	**(Black $_b$1965)**
	Silt	388		
	Clay	304		
Texture		Clay Loam		
Bulk density		1.53	Mgm^{-3}	
Total bacteria		$25.81x10^6$	$CFUg^{-1}$ dry soil	
Total fungi		$13.72x10^3$		
The effectiveness of the enzyme urease		33.23	µg $N\text{-}NH_4^+g^{-1}$ soil2h^{-2}	**(Tabatabai and Bremner ، 1972)**

The experiment was conducted after distributing the 16 treatments Table (2) on the divided plots according to the design of the Randomized Complete e Block Design (RCBD)and with three

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replications. The treatments and their replicates resulted in 48 experimental units, including the control treatment. Dry rice seeds (cultivars Amber 33) obtained from the Rice Research Station in Al-Mishkhab district / Najaf province, were sown with an amount of 120 $kg.ha^{-1}$ seeds by hand scattering. Urea nitrogen fertilizer was added to all experimental units to ensure balanced growth of plants in all experimental units by 300 $kg.ha^{-1}$. The third batch is at the beginning of the liner phase, where the last quarter of the recommendation was added.Complete nanoparticles (NC) and nanosilicon NS were added in two batches, the first at the stage of elongation and the second at the stage of branching, as well as the mineral DAP fertilizer M-DAP, which contains (18%) nitrogen and (46%) phosphorous in two batches, the first at the vegetative growth stage and the second At the branching stage.As for the organic fertilizer O-DAP that contains (16.5%) nitrogen and (48.2%) phosphorous and (2.14%) potassium, it was added in two batches, the first at the vegetative growth stage and the second at the branching stage, as for the high potassium organic DAP fertilizer O - DAP High K, which contains (18%) nitrogen, (7%) phosphorous and (46%) potassium, added in two batches, the first at the vegetative growth and the second at the branching stage.

Table (2) Distribution of experiment treatments with symbols and their fertilizer recommendation

No.	Treatments	treatments symbol with its fertilizer recommendation
1	Control	Without adding
2	Nano Silicon	NS (2 $ml.L^{-1}$)
3	Nano Complet	NC (2 $g.L^{-1}$)
4	Mineral –DAP	M-DAP (240 $kg.ha^{-1}$)
5	Organic-DAP	O-DAP (240 $kg.ha^{-1}$)
6	Organic DAP High K	O-DAP high-K (240 $kg.ha^{-1}$)
7	Nano Silicon +Nano complet	NS (2 $ml.L^{-1}$) + NC (2 $g.L^{-1}$)
	Mineral –DAP+ Nano Silicon	M-DAP (240 $kg.ha^{-1}$) +NS (2 $ml.L^{-1}$)
9	Mineral –DAP+ Nano complet	M-DAP (240 $kg.ha^{-1}$) + NC (2 $g.L^{-1}$)
10	Organic-DAP + Nano Silicon	O-DAP (240 $kg.ha^{-1}$) + NS 2 $ml.L^{-1}$)
11	Organic-DAP + Nano complet	O-DAP (240 $kg.ha^{-1}$) + NS 2 ($ml.L^{-1}$) + NC (2$g.L^{-1}$)
12	Organic DAP High K+ Nano Silicon	(240$kg.Ha^{-1}$) O-DAP high-K NS + 2$ml.L^{-1}$)
13	Organic DAP High K+ Nano complet	O-DAP high-K (240 $kg.ha^{-1}$) NS + 2 $ml.L^{-1}$)
14	Mineral –DAP+ Nano Silicon + Nano complet	M-DAP (240 $kg.ha^{-1}$) + NS (2$ml.L^{-1}$) + NC (2$g.L^{-1}$)
15	Organic-DAP + Nano + Silicon Nano complet	O-DAP (240 $kg.ha^{-1}$) + NS (2$ml.L^{-1}$) + (NC (2$g.L^{-1}$)

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16	Organic DAP High K+Nano Silicon + Nano complet	O-DAP high-K (240 kg.ha^{-1}) + NS (2 ml.L^{-1}) + NC (2g.L^{-1})

The activity of the urease enzyme was estimated in the rhizosphere and outside it of the rice plants after (35 , 65 and 95) days of cultivation. The activity of the urease enzyme was estimated according to the method of Tabatabai and Bremner (1972) by incubating 5 g of the soil of the ocean root and away from it in a 50 ml volumetric flask. With 0.2 ml of coloring and 9 ml of Tris (hydroxyl methyl amino methan) buffer solution with pH = 9 and 1 ml of 0.2 M urea solution as subject material at 37 ° C for two hours and then add 35 ml of potassium chloride solution 2.5 Molari silver sulfate ppm100 as an inhibitor and complete e the volume to 50 mL of the same solution. Then the ammonium nitrogen resulting from the enzyme activity was estimated using a Micro-kjeldahl steam distillation apparatus according to the Bremner method mentioned in Black 1965b) and using magnesium oxide and boric acid.

Results and Discussion

The effectiveness of the urease enzyme µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1} in and outside the rhizosphere after 35, 65 and 95 days after cultivation .

The results in Table (3 and 4) indicate that there are significant differences between the treatments of adding DAP fertilizer (Control, M-DAP, O-DAP, O-DAP High K) in the average activity of the urease enzyme after 35 days of cultivation in the rhizosphere and outside of the rice plant. The O-DAP treatment gave the highest average (50.28 and 46.43 µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1} in respectively compared to the Cont DAP treatment, which gave the lowest average (38.81 and 35.51) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1} respectively.The reason for the treatment of O-DAP significantly excelled on the rest of the treatments is due to the formulation of the organic DAP fertilizer fortified with micronutrients, which encouraged the activity of micro-organisms located in and outside the rhizosphere, thus increasing the amount of urease enzyme secreted and this is in agreement with (Al-Jabri, 2010; Long, 2016; Aswathy & Jose, 2013).Water saturation leads to a significant accumulation of organic matter resulting from anaerobic metabolism by anaerobic microorganisms in the soil (Shabala, 2011).The results in Table (3) showed that there is a significant difference in the treatment of nano silicon fertilizer NS in the average activity of the urease enzyme in the rhizosphere. It gave a mean of (48.44) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1} compared to the control treatment Cont NS, which gave an average (43.40) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1} 35 days after cultivation.While the same treatment did not record significant differences in outside the rhizosphere, Table (4), the reason for the excelled of the NS treatment in significant methods can be explained by the same trend for normal silicon behavior, given that the mechanism of action of leaves-added nano scale silicon has not yet been clarified in the available studies, Stable silicon acid is classified as a biostimulant similar to biostimulants derived from fermentation microscopy, both biostimulants increase Vegetative length and leaf area positively reflected on biomass (Saa et al. 2015 Prakash et al., 2008; Prakash et al., 2011) . The results in Table (3, 4) showed that there is a significant difference in the treatment of Complete nanofertilizer NC in the average activity of the urease enzyme in the rhizosphere and outside it, where it gave the highest average of (48.50 and 45.09) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1} on respectively, compared to Cont NC treatment, which gave the lowest mean of (43.35 and

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39.01) µg $N^-NH_4{}^+$ g^{-1} soil2h$^-$ on respectively. The reason for the excelled on the treatment NC significantly is due to the absorption and transfer of nanoparticles or the transformation and accumulation in plants. This is a very important case related to the type of plant and the growth stage and the nanoparticle nutrition, and the nanoparticles have a high ability to penetrate and enter the various plant tissues, especially the additive spray on the shoots (DK et al., 2017 Ruttkay; Kharun, 2017 Tripathi; et al., 2017 ; Zuverza-Mena et al., 2017). The nanoparticles that can be sprayed on the surfaces of plant leaves can enter through the stomata pores (openings) or through the base of the capillaries to move towards the various plant tissues, which led to an increase in the activity of the radical secretion in the rhizosphere, which encouraged the increase in microbial activity that led There was a significant increase in the activity of urease enzyme in the rhizosphere and outside of the rice plant (Hatami et al. 2016; Singh et al., 2017, Rastogi; et al., 2017).It is noticed from Table (3 and 4) that there were significant differences in the treatment of the bi-interaction between DAP fertilizer and NS in the mean activity of the urease enzyme, where the treatment (O-DAP + Ns) gave the highest average of (53.72 µg $N^-NH_4{}^+$ g^{-1} soil2h^{-1} compared to the control treatment Cont DAP and Cont NS, which gave the lowest average of 29.40) µg $N^-NH_4{}^+$ g^{-1} soil2h^{-1} in the rhizosphere. While the (M-DAP + Cont NS) treatment recorded the highest average of (53.84) µg $N^-NH_4{}^+$ g^{-1} soil2h^{-1}compared to the control treatment Cont DAP and Cont NS, which gave the lowest average of (27.73) µg $N^-NH_4{}^+$ g^{-1} soil2h^{-1} is in an area outside the rhizosphere. . The results in Table (4) showed that there were significant differences in the treatment of the bi-interaction between the DAP fertilizer and NC in the average activity of the urease enzyme in an area outside the rhizosphere, where the treatment (M-DAP + NC) gave the highest average of 48.85 µg $N^-NH_4{}^+$ g^{-1} soil2h^{-1} compared to the control treatment DAP Cont and Cont NC, which gave the lowest average of (27.61) µg $N^-NH_4{}^+$ g^{-1} soil2h^{-1}, while the treatment of bi-interaction between DAP and NC fertilizer did not record a significant effect in the rhizosphere Table (3).The treatment of bi-interaction between the NS and NC fertilizer gave significant differences in the average activity of the urease enzyme in an area outside the rhizosphere, Table (4). The treatment (Cont + NC) gave the highest average of (47.00) µg $N^-NH_4{}^+$ g^{-1} soil2h^{-1}. Compared to control treatment Cont NS and Cont NC, which gave the lowest mean (36.46) µg $N\text{-}NH_4{}^+$ g^{-1} soil2h^{-1}, While the interaction treatment (NS and NC) did not have a significant effect on the rhizosphere. The results of the table show that there are significant differences in the triple interaction between the treatment of fertilizer addition (DAP and NS and NC) in the average activity of the enzyme urease in the rhizosphere. The addition of O-DAP+ NS+ Cont NC gave the highest mean of (55.19) µg $N^-NH_4{}^+$ g^{-1} soil2h^{-1}compared to the control treatment DAP Cont, Cont NS, and Cont NC, which gave the lowest mean of (21.29)µg $N\text{-}NH_4{}^+$ g^{-1} soil2h^{-1} While the triple interaction treatment between DAP fertilizer, NS and NC fertilizer did not record a significant effect in an area outside the rhizosphere Table (4).

Table (3) The effect of dab fertilizer levels and nanosilicon and complete nanostructures on the activity of the urease enzyme (µg $N^-NH_4{}^+$ g^{-1} soil2h^{-1}) in the rhizosphere after 35 years of cultivation

DAP addition levels	DAP Cont	M-DAP	O-DAP	O-DAP High K
	38.81	47.88	50.28	46.73
L.S.D	4.149			

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NS addition levels		ContNS		NS	
		43.40		48.44	
L.S.D		2.934			
NC addition levels		Cont NC		NC	
		43.35		48.50	
L.S.D		2.934			
Bi-interaction between DAP and NS					
Cont DAP			M-DAP	O-DAP	O-DAP High K
NS Cont		29.40	51.60	46.85	45.77
NS		48.22	44.16	53.72	47.68
L.S.D		5.868			
Bi-interaction between DAP and NC					
Cont DAP			M-DAP	O-DAP	O-DAP High K
NC Cont		33.97	46.89	49.59	42.95
NC		43.65	48.87	50.97	50.50
L.S.D		5.868			
Bi-interaction between NS and NC					
ContNS				NS	
NC Cont		40.48		46.33	
NC		46.22		50.67	
L.S.D		4.149			
Triple interaction between DAP, NS, and NC					
		Cont DAP	M-DAP	O-DAP	O-DAP High K
ContNS	Cont NC	21.29	52.61	43.99	44.03
	NC	37.50	50.58	49.71	47.51
NS	Cont NC	46.64	41.17	55.19	41.88
	NC	49.79	47.15	52.24	53.49
L.S.D		8.299			

Table (4) The effect of levels of DAP fertilizer and nanosilicon and complete nanostructures on the activity of the urease enzyme (μg $N^{-}NH_4{}^{+}$ g^{-1} $soil 2h^{-1}$) in the area outside after 35 days of cultivation

DAP addition levels	DAP Cont	M-DAP	O-DAP	O-DAP High K
	35.51	44.99	46.43	41.25
L.S.D	3.894			
NS addition levels	ContNS		NS	
	41.73		42.37	
L.S.D	2.754			
NC addition levels	Cont NC		NC	
	39.01		45.09	
L.S.D	2.754			

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Bi-interaction between DAP and NS				
Cont DAP		M-DAP	O-DAP	O-DAP High K
NS Cont	27.73	53.84	44.88	40.47
NS	43.30	36.15	47.99	42.03
L.S.D	5.507			
Bi-interaction between DAP and NC				
Cont DAP		M-DAP	O-DAP	O-DAP High K
NC Cont	27.61	41.14	48.17	39.12
NC	43.41	48.85	44.69	43.38
L.S.D	5.507			
Bi-interaction between NS and NC				
ContNS			NS	
NC Cont	36.46		41.56	
NC	47.00		43.17	
L.S.D	3.894			

Triple interaction between DAP, NS, and NC					
		Cont DAP	M-DAP	O-DAP	O-DAP High K
ContNS	Cont NC	18.38	47.90	41.31	38.23
	NC	37.08	59.77	48.45	42.70
NS	Cont NC	36.84	34.38	55.03	40.00
	NC	49.75	37.93	40.94	44.07
L.S.D		7.788			

The results of the statistical analysis indicate, as in Table (5 and 6), that the addition of DAP fertilizer (Control, M-DAP, O-DAP, O-DAP High K) led to significant differences after 65 days of cultivation in the average of the activity values of the enzyme urease in the rhizosphere and outside of the rice plant, the O-DAP treatment of the two regions, respectively, gave the highest mean of (74.69 and 69.5) µg $N^-NH_4{}^+ g^{-1}$ soil2h^{-1}) compared to the control treatment DAP Cont, which gave the lowest average of the effectiveness values of (57.65 and 52.4) µg $N^-NH_4{}^+ g^{-1}$ soil2h^{-1} that the reason for the excelled of the treatment of O-DAP may be due to the addition of organic dab fertilizer which led to an increase in the readiness of the major and minor elements, including phosphorous and nitrogen, and the increase in the activity of micro-organisms that work on mineral The elements were organically grown through secretion of the enzyme urease from the same organisms or from plant roots in the peripheral area, which led to an increase in the activity of the urease enzyme (Al-Khuzai, 2020; expected, 2019). The results of the two tables show that there is a significant difference in the treatment of NS fertilizer In the average activity of the enzyme urease in the rhizosphere and outside of the rice plant, it gave the treatment of N S averaged (68.48 and 60.9) µg $N^-NH_4{}^+ g^{-1}$ soil2h^{-1}in the sequence compared to the control treatment Cont NS, which gave a mean of (55.9 and 63.74) µg $N^-NH_4{}^+ g^{-1}$ soil2h^{-1}, The results of the two tables show that there is a significant difference in the treatment of NS fertilizer in the

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average activity of the urease enzyme in the rhizosphere area and outside of the rice plant. NS which gave a mean of (55.9 and 63.74) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1}, The reason for the significantly excelled of the NS treatment is, as mentioned (Bent, 2014) that spraying with solutions of silicone added foliar leads to improved root growth of the rice plants compared to the control plants.It is noticed from the results of the two tables that there is a significant difference in the treatment of NC fertilizer in the average activity of the urease enzyme in the rhizosphere and outside it, where the NC treatment gave the highest average of (70.96 and 64.4) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1}respectively compared to the control treatment Cont NC Which gave an average of (61.27 and 52.4) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1}. The reason for the significance of NC treatment was significant due to the combination of the Complete nano fertilizer, as it increased the absorption and use of nutrients by the rice plant, In addition, nanotechnology can provide mechanisms to synchronize nitrogen release from fertilizers with crop requirements and increase the activity of nitrogen-producing organisms by increasing their secretion of hydrolysis enzymes (Fujinuma and Balster, 2010). It led to a significant increase in the activity of the enzyme urease in the rhizosphere and outside of the rice plant. Tables (5 and 6) indicate the presence of significant differences in the treatment of the bi-interaction between the fertilizer (DAP and NS) in the average activity of the urease enzyme in the rhizosphere and outside it, where the treatment (O-DAP + Ns) gave the highest average of (79.99 and 73.3) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1} on the sequence as compared to the control treatment for DAP Cont and Cont NS which gave a mean (48.94 and 41.8) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1}on respectively.It is also noticed from the results of the two tables that there are significant differences in the treatment of the bi-interaction between the DAP fertilizer and the NC in the values of the activity of the urease enzyme in the rhizosphere after 65 days of cultivation the treatment (O-DAP + Nc) gave the highest average of (80.14) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1} compared to the control treatment DAP Cont and Cont NC, which gave an average (46.48) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1} Table (5) and no significant difference treatment was recorded in the far region of the rhizosphere, Table (6) The results of the two tables show that there were no significant differences in the treatment of the bi-interaction between (NS and NC) fertilizers in the values of the activity of the enzyme urease in the rhizosphere and outside it. The results of the two tables show that there were significant differences in the treatment of the triple interaction between DAP fertilizer and NS and NC fertilizer in the values of the activity of the urease enzyme in the rhizosphere and outside it. The treatment of O-DAP + NS + NC gave the highest average of (85.95 and 79.5) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1}on the relay by compared with the control treatment Cont DAP Cont NS and Cont NC (29.08 and 23.8) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1}

Table (5) The effect of DAP fertilizer levels and Nano silicon and complete nanostructures on the activity of the urease enzyme (µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1}) in the rhizosphere after 65 days of cultivation of the rice plant

DAP addition levels	DAP Cont	M-DAP	O-DAP	O-DAP High K
	57.65	67.27	74.69	64.84
L.S.D	5.282			
NS addition levels	ContNS		NS	
	63.74		68.48	
L.S.D	3.735			

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NC addition levels		Cont NC		NC	
		61.27		70.96	
L.S.D		3.735			
Bi-interaction between DAP and NS					
Cont DAP			M-DAP	O-DAP	O-DAP High K
NS Cont		48.94	71.14	69.38	65.51
NS		66.37	63.40	79.99	64.16
L.S.D		7.470			
Bi-interaction between DAP and NC					
Cont DAP			M-DAP	O-DAP	O-DAP High K
NC Cont		46.48	68.92	69.23	60.43
NC		68.82	65.62	80.14	69.24
L.S.D		7.470			
Bi-interaction between NS and NC					
ContNS				NS	
NC Cont		59.67		62.86	
NC		67.82		74.10	
L.S.D		N.C			
Triple interaction between DAP, NS, and NC					
		Cont DAP	M-DAP	O-DAP	O-DAP High K
ContNS	Cont NC	29.08	78.23	64.43	66.94
	NC	68.79	64.05	74.34	64.08
NS	Cont NC	63.88	59.62	74.04	53.92
	NC	68.86	67.19	85.95	74.40
L.S.D		10.564			

Table (6) The effect of DAP fertilizer levels and integrated nanosilicon and complete nanostructures on the activity of the urease enzyme (µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1}) in an area outside the rhizosphere 65 days after cultivation

DAP addition levels	DAP Cont	M-DAP	O-DAP	O-DAP High K
	52.4	57.8	69.5	53.9
L.S.D	5.89			
NS addition levels	ContNS		NS	
	55.9		60.9	
L.S.D	4.16			
NC addition levels	Cont NC		NC	
	52.4		64.4	
L.S.D	4.16			
Bi-interaction between DAP and NS				
Cont DAP		M-DAP	O-DAP	O-DAP High K

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NS Cont		41.8	62.6	65.7	53.3
NS		62.9	53.0	73.3	54.5
L.S.D		8.32			
Bi-interaction between DAP and NC					
Cont DAP			M-DAP	O-DAP	O-DAP High K
NC Cont		43.3	56.5	63.9	46.1
NC		61.4	59.2	75.1	61.7
L.S.D		8.32			
Bi-interaction between NS and NC					
ContNS				NS	
NC Cont		50.6		54.3	
NC		61.2		67.6	
L.S.D		N.C			
Triple interaction between DAP, NS, and NC					
		Cont DAP	M-DAP	O-DAP	O-DAP High K
ContNS	Cont NC	23.8	65.5	60.7	52.3
	NC	59.8	59.8	70.7	54.4
NS	Cont NC	62.8	47.4	67.1	39.9
	NC	63.0	58.6	79.5	69.1
L.S.D		11.77			

The results of the statistical analysis in Table (7) indicate that the addition of (Control, M-DAP, O-DAP, O-DAP High K) fertilizer led to significant differences after 95 days of cultivation in the average of the activity values of the enzyme urease in the rhizosphere of the rice plant. The treatment of O-DAP High K gave the highest average of (91.7) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1}compared to the control treatment DAP Cont, which gave the lowest average of the effectiveness values of (75.0) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1}.While there were no significant differences in the levels of adding dab fertilizer in an area outside the rhizosphere, Table (8) the reason for the O-DAP High K treatment was significantly superior to the rest of the treatments may be due to the increase in biological activity in the root zone during this period, in addition to the abundance of the DAP fertilizer composition. Organic, high-potassium, containing humic acids, important nutrients as well as increasing the availability of nutrients around the root zone (Mitran et al., 2018 Al-Khuzai,; 2020 Montaed, 2019) .The absence of a significant difference in an area outside the rhizosphere is due to the drag force generated by the roots of the rice plant on an area outside the rhizosphere when the elements in the root zone run out due to the continuous plant need after 95 days of planting, which led to a significant increase in the activity of the urease enzyme in the rhizosphere.The results of the two tables indicate that there is no significant difference in the treatment of silicon nano fertilizer NS in the average activity of the urease enzyme in the rhizosphere and beyond. The results of the same tables show that there is a significant difference in the treatment of Complete nano fertilizer NC in the average activity of the urease enzyme in the rhizosphere and outside it, where

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the NC treatment gave the highest average of (93.4 and 86.1) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1}respectively compared to the treatment The Cont NC , which gave a mean of (78.9 and 69.6) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1} in respectively. The reason for the significantly excelled of the NC treatment is due to the role of nanoparticles with its high surface area, which leads to an increase in the amount of enzyme adsorbed on its surfaces and thus leads to an increase in the amount of the enzyme. These activities, which increase the activity of the micro-organisms, in addition to the enzymes contained in these secretions (Grover, 2012). The results of the two tables show that there are significant differences in the treatment of the bi-interaction between DAP fertilizer and NS in the average activity of the urease enzyme in an area outside the rhizosphere. The treatment of O-DAP and Cont NS gave the highest average of (82.5) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1}compared to by the control treatment DAP Cont and Cont NS which gave a mean (62.3) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1},Where, the bi-interaction treatment between DAB fertilizer and nano silicon fertilizer did not record a significant difference in the rhizosphere. The results of the two tables show that there are significant differences in the treatment of the bi-interaction between the DAP fertilizer and the NC fertilizer treatment in the values of the urease enzyme activity in an area outside the rhizosphere. The Cont O-DAP and NC treatment gave the highest average of (90.2) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1}by compared with the control treatment DAP Cont and Cont NC, which gave a mean (54.2) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1}, and the same treatment did not record a significant difference in the rhizosphere. It was also noticed that there were no significant differences in the treatment of the bi-interaction between the NS fertilizer and the NC fertilizer treatment in the values of the activity of the enzyme urease in the rhizosphere and outside of the rice plant. The results of the two tables show that there are significant differences in the triple interaction between DAP fertilizer and NS and NC treatment in the values of the activity of the urease enzyme compared to the treatment The O-DAP High K and NS and NC in the rhizosphere and O-DAP High and Cont Ns and NC outside it which gave a mean of (103.5 and 92.3) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1}on the sequence compared to the treatment Cont DAP, Cont NS, and Cont NC which gave an average (47.0 and 35.4) µg $N^{-}NH_4{}^{+}$ g^{-1} soil2h^{-1}on the sequence The reason for the superiority of the triple interaction treatment is due to the reason In that the significantly to the root secretions of plants that contain amino acids, sugars and organic acids, as well as the enzymes that are secreted in addition to the high activity and bio-activity, as well as what the DAP fertilizer and nanofertilizers add to the nutrients in the peripheral area of the root and beyond it.

Table (7) The effect of DAP fertilizer levels and nanosilicon and complete nanostructures on the activity of the urease enzyme (µg N-NH4 + g-1 soil2h-1) in the rhizosphere after 95 days of cultivation

DAP addition levels	DAP Cont	M-DAP	O-DAP	O-DAP High K
	75.0	89.4	88.6	91.7
L.S.D	8.26			
NS addition levels	ContNS		NS	
	84.3		88.1	
L.S.D	N.C			
NC addition levels	Cont NC		NC	
	78.9		93.4	
L.S.D	5.84			

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Bi-interaction between DAP and NS					
Cont DAP			M-DAP	O-DAP	O-DAP High K
NS Cont		67.6	90.6	86.2	92.6
NS		82.3	88.3	91.0	90.8
L.S.D		11.68			
Bi-interaction between DAP and NC					
Cont DAP			M-DAP	O-DAP	O-DAP High K
NC Cont		64.7	82.7	87.0	81.4
NC		85.2	96.2	90.2	102.0
L.S.D		11.68			
Bi-interaction between NS and NC					
ContNS				NS	
NC Cont		77.1		80.8	
NC		91.4		95.4	
L.S.D		N.C			
Triple interaction between DAP, NS, and NC					
		Cont DAP	M-DAP	O-DAP	O-DAP High K
ContNS	Cont NC	47.0	87.7	89.0	84.8
	NC	88.2	93.5	83.5	100.5
NS	Cont NC	82.3	77.8	85.0	78.0
	NC	82.2	98.8	96.9	103.5
L.S.D		16.52			

Table (8) The effect of levels of DAP fertilizer and nanosilicon and complete nanostructures on the activity of the urease enzyme (μg N-NH4 + g-1 soil2h-1) in an area outside the rhizosphere after 95 days of cultivation

DAP addition levels	DAP Cont	M-DAP	O-DAP	O-DAP High K
	72.2	78.1	79.8	81.2
L.S.D	6.86			
NS addition levels	ContNS		NS	
	76.5		79.2	
L.S.D	N.C			
NC addition levels	Cont NC		NC	
	69.6		86.1	
L.S.D	4.85			
Bi-interaction between DAP and NS				
Cont DAP		M-DAP	O-DAP	O-DAP High K
NS Cont	62.3	80.1	82.5	81.3
NS	82.2	76.2	77.2	81.1

L.S.D		9.70			
Bi-interaction between DAP and NC					
		Cont DAP	M-DAP	O-DAP	O-DAP High K
NC Cont		54.2	70.6	78.6	74.9
NC		90.2	85.6	81.1	87.5
L.S.D		9.70			
Bi-interaction between NS and NC					
		ContNS		NS	
NC Cont		67.4		71.8	
NC		85.7		86.5	
L.S.D		N.C			
Triple interaction between DAP, NS, and NC					
		Cont DAP	M-DAP	O-DAP	O-DAP High K
ContNS	Cont NC	35.4	79.3	84.5	70.3
	NC	89.1	80.8	80.5	92.3
NS	Cont NC	73.0	61.9	72.7	79.6
	NC	91.3	90.5	81.7	82.7
L.S.D		13.72			

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