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Response of Cow pea (Vigna unguiculata L.) to seeds rate and Foliar spray of Ca Nanoparticles

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Abstract:

Field experiment conducted at summer in two season 2020-2021 and 2021-2022 on clay sandy soil in Al-Diwanyia. The experiment was design as Complete randomized block designing with three replications arranged for split-pilot design, and Lest Significant Deference's(LSD) $_{0.05}$ the main treatment contend two groups seeds rate 25 and 50 Kg ha^{-1} within there four levels of Nano Ca(0 , 30 , 60 , 90) PPM I took sample of soil before planting to analysis it and to learn physical and chemical properties table 1. Cowpea(*Vigna unguiculata L.*) were sowing at two rates 25 and 50kg.ha^{-1}(3 cm depth) at 1/4 , after 7 months I took a samples to measure . The results showed all factors and interactions were significant effect and increased all growth traits (plant height, number of leaves per plant and stem diameter , plant content of protein , carbohydrate total Chlorophyll and fats and active substances ,) lead to increased grain yield max values (2.72 Ton.ha^{-1}) at interaction of 25 seeds rate and 90 ppm Ca Nanoparticles level, while min value(1.9 Ton.ha^{-1}) at interaction 50 seed rate and 0 ppm Ca Nanoparticles level.

Keywords seeds rate, foliar spray , Cow pea ,Nano Ca

I. INTRODUCTION

Cow pea(*Vigna unguiculata*L.) one of main sources of protein Cowpea contend 20-24% protein , 63.3% carbohydrates and 1.9% fat (Sengiz 2022). also one of the medical plants (Duke et al 2002 ; Belete and Mulugeta 2022) also Bio remediater because ability to remove heavy metals like Cadmium from soil. (Burd et al 2000) . Planting seeds of Cowpea in four seeds rates (6 , 12 , 18 ,24) kg ha^{-1} increased seeds rates increased plant height and decreased stem diameter, number of leaves per plant and leaves area index in 24 kg.ha^{-1} (Ahmed et al 2011) Chelating Nano fertilizer good fertilizer because ecofriendly in slow release and increased Common pea resistances to biotic and abiotic stress . (Al-Burki et al 2021) Foliar spray of Nano Calcium and 2g Urea increased all growth features of Cucumber(Yahya, and Karim 2021). Foliar spray of Ca Nanoparticles on Chickpea Improved seeds weight and increased grain yield Mahan et al 2015).This study aimed to learn effects seeds rate and Ca Nanoparticles on growth and chemical structure of Cowpea.This study aimed to know effects of seeds rate and foliar spray Ca Nanoparticles on Cowpea

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II. MATERIALS AND METHODS

Seeds of Cowpea inoculated with solution of *Rhizobium alkali* L(Kadhimyah et al 2020) cultures prepare from crushed sterile old root nodule with one drop of distal water then incubated at 30 ^{o}C to 3-7 days(Mensoh et al 2006 ; Jose et al 2020). So as to stimulate bio fertilizers also all treatments fertilized with 20 kg.ha^{-1} Urea $_{(47\%N)}$to stimulate *nif* H gene it responsible on nitrogenase formation(Jiang et al 2021). Add 10ml of methanol $_{(100\%)}$ on seeds powder and mixing at 10min.Then store at 6h in dark place then filtered 4.5µ and Iam add 1ml hexan$_{(100\%)}$ then analysis by GC-Mass.. Analysis of fats by dissolved 10 g of seeds powder with 10 ml Hexane $_{100\%}$and inter to sexhlet .While analysis of carbohydrates depend on Herbert et al 1973 other measures (AOAC2000)

Tabl(1) showed analydis of soil before planting

Soil		
Value	**Unite**	**Properties**
7.65	**------**	**Soil PH**
7.34		**Water PH**
257	**(µS/cm)**	**Electrcal conductivity**
4.45	**g.kg^{-1} of soil**	**Organic matter**
73.87	**mg.kg^{-1} of soi**	**A voluble nitrogen**
41.77		**A voluble phosphor**
74		**A voluble patassium**
246	**g.kg^{-1} of soi**	**Sand**
172.4		**Silt**
736.8		**Clay**
Sandy – clay soil		**Texture**

III. RESULTS AND DISCUSSION

1- Plant height (cm):

Table(2)showed significant effect of 50 Kg ha^{-1} rate on Plant height (cm) max value(71.91) of Cow pea (*Vigna unguiculata* L.) because increased plant density in this rate and increased shading lead to increased Gibrlic acid causes increased plant height and logging (Emongor 2007) this conformity with Ahmed et al 2011),also showed significant effect of Ca Nanoparticles on Plant height (cm)of Cow pea max value(69.45) in treatment 90 ppm because of increased Nano element passed through plasma membrane it is very small size and increased activity of nitrogenase in roots nodules (Shaw and Long 2003) and Novel protein kinases enzymes (Shi et al 1999).and water stress compound like absesic acid (Staxen et al 1999) this conformity with Al-Burki et al 2021) .also showed significant effect of interaction of Ca Nanoparticles and seeds rate max value(75.46) in treatment 50 Kg ha^{-1} and 90 ppm because of roles of Ca Nanoparticlesas stimulator nitrogenase(Shaw and Long 2003) and peroxidases and phenylalanine ammonia lays and phenolic compounds and lignin (Aline et al 2006)also this accepted with Yahya and Karim 2021).the differences between years depend

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on wind speed which increased soil plant atmospheric continuous and increased up take of elements and stem diameter.(**Emmanual 2008).**

Table (2) effect of seed rate and Ca Nanoparticles **on plant height cm** in Cow pea at 2020-2021

Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	
45.05	62.52	59.61	43.49	53.54	25 kg.ha^{-1}
62.98	74.54	71.54	31.44	65.54	50 kg .ha^{-1}
LSD a = 0..33	68.55	65.58	37.46	59.54	Average of Ca Nanoparticles effect
	LSD a*b= 0.27				LSD b= 0.16

effect of seed rate and Ca Nanoparticles on **plant height cm** in Cow pea at 2021-2022

Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	
60.66	63.43	61.56	59.69	57.95	25 kg.ha^{-1}
71.91	75.46	73.23	70.44	68.52	50 kg .ha^{-1}
LSD A= 0.1	69.45	67.4	65.6	63.23	Average of Ca Nanoparticles effect
	LSD A*B= 0.5				LSD B= 0.62

2-Number of leaves per plant :

Table(3)showed significant effect of 25 Kg ha^{-1} rate on Number of leaves per plant max value(50.48) of Cow pea (*Vigna unguiculata* L.) because decreased plant density in this rate and decreased shading lead to increased plant branching causes increased Number of leaves per plant this conformity with Ahmed et al 2011),also showed significant effect of Ca Nanoparticles on Number of leaves per plant of Cow pea max value(49.78) in treatment 90 ppm because of increased Nano element passed through plasma membrane it is very small size and increased activity of nitrogenase in roots nodules (Shaw and Long 2003) and Novel protein kinases enzymes (Shi et al 1999).and water stress compound s like absesic acid (Staxen et al 1999) this conformity with Al-Burki et al 2021) .also showed significant effect of interaction of Ca Nanoparticles and seeds rate max value(52.69) in treatment 25Kg ha^{-1} and 90 ppm because of roles of Ca Nanoparticles as stimulator nitrogenase(Shaw and Long 2003) and peroxidases and phenylalanine ammonia lyase and phenolic compounds and lignin (Aline et al 2006)also this accepted with Yahya and Karim 2021). the differences between years depend on wind speed which increased soil plant atmospheric continuous and increased up take of elements and stem diameter.(**Emmanual 2008).**

Table (3) effect of seed rate and Ca Nanoparticles **on number of leaves per plant** in Cow pea at 2020-2021

Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	
45.05	49.54	46.66	43.49	40.52	25 kg.ha^{-1}

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32.98	37.48	34.51	31.44	28.5	50 kg .ha^{-1}
LSD a = 0.23	43.51	40.58	37.46	34.51	Average of Ca Nanoparticles effect
	LSD a*b= 0.28				LSD b= 0.21
effect of seed rate and Ca Nanoparticles on **number of leaves** in Cow pea at 2021-2022					
Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	
50.48	52.69	51.05	49.54	48.64	25 kg.ha^{-1}
44.77	46.88	45.45	44.05	42.72	50 kg .ha^{-1}
LSD A= 0.25	49.78	48.25	46.8	45.68	Average of Ca Nanoparticles effect
	LSD A*B= 0.27				LSD B= 0.44

3- Stem diameter cm:

Table(4)showed significant effect of 25 Kg ha^{-1} seeds rate on Stem diameter max value(1.08 cm) of Cow pea (*Vigna unguiculata* L.) because decreased plant density in this rate and decreased shading lead to increased plant movement causes increased Stem diameter this conformity with Ahmed et al 2011),also showed significant effect of Ca Nanoparticles on Stem diameter of Cow pea max value(1.07 cm) in treatment 90 ppm because of increased Nano element passed through plasma membrane it is very small size and increased activity of nitrogenase in roots nodules (Shaw and Long 2003) and Novel protein kinases enzymes (Shi et al 1999).and water stress compounds like abasic acid (Staxen et al 1999) this conformity with Al-Burki et al 2021).also showed significant effect of interaction of Ca Nanoparticles and seeds rate max value(1.13 cm) in treatment 25 Kg ha^{-1} and 90 ppm because of roles of Ca Nanoparticles as stimulator nitrogenase(Shaw and Long 2003) and peroxidases and phenylalanine ammonia lyase and phenolic compounds and lignin (Aline et al 2006)also this accepted with Yahya and Karim 2021). the differences between years depend on wind speed which increased soil plant atmospheric continuous and increased up take of elements and stem diameter .(**Emmanual 2008).**

Table (4) effect of seed rate and Ca Nanoparticles **on stem diameter cm** in Cow pea at 2020-2021					
Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	
1.02	1.13	1.07	0.97	0.94	25 kg.ha^{-1}
0.86	0.91	0.88	0.85	0.82	50 kg .ha^{-1}
LSD a = 0.03	1.02	0.97	0.91	0.88	Average of Ca Nanoparticles effect
	LSD a*b= 0.06				LSD b= 0.02
effect of seed rate and Ca Nanoparticles on **stem diameter** in Cow pea at 2021-2022					
Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	
1.08	1.13	1.1	1.06	1.03	25 kg.ha^{-1}

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0.95	1	0,96	0.94	0.91	50 kg .ha^{-1}
LSD A= 0.01	1.07	1.03	1	0.97	Average of Ca Nanoparticles effect
	LSD A*B= 0.008				LSD B= 0.01

4- Protein percent %:

Table(5)showed significant effect of 25 Kg ha^{-1} rate on Protein percent % max value(25.82%) of Cow pea (*Vigna unguiculata* L.) because decreased plant density in this rate and decreased shading lead to increased aeration of soil causes increased alkalinity of soil (Melvin 1945) this good environment to *Rhizobium elkanii* L.(Kadhimyah et al 2020) and increased activity of roots nodules in protein synthesis enzymes this conformity with Ahmed et al 2011),also showed significant effect of Ca Nanoparticles on Protein percent % of Cow pea max value(25.47 %) in treatment 90 ppm because of increased Nano element passed through plasma membrane it is very small size and increased activity of nitrogenase in roots nodules (Shaw and Long 2003) and Novel protein kinases enzymes (Shi et al 1999).and water stress compound like abasic acid (Staxen et al 1999) this conformity with Al-Burki et al 2021) .also showed significant effect of interaction of Ca Nanoparticles and seeds rate max value(27.01 %) in treatment 25 Kg ha^{-1} and 90 ppm because of roles of Ca Nanoparticles as stimulator nitrogenase(Shaw and Long 2003) and peroxidases and phenylalanine ammonia lyase and phenolic compounds and lignin (Aline et al 2006)also this accepted with Yahya and Karim 2021). the differences between years depend on wind speed which increased soil plant atmospheric continuous and increased up take of elements and stem diameter .(**Emmanual 2008).**

Table (5) effect of seed rate and Ca Nanoparticles on protein percent % in Cow pea at 2020-2021

Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	
24.37	25.5	24.73	23.98	23.28	25 kg.ha^{-1}
21.57	22.57	21.89	21.23	20.58	50 kg .ha^{-1}
LSD a= 0.08	24.03	23.31	22.61	21.93	Average of Ca Nanoparticles effect
	LSD a*b= 0.06				LSD b= 0.02

effect of seed rate and Ca Nanoparticles on protein percent % in Cow pea at 2021-2022

Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	
25.82	27.01	26.22	25.42	24.64	25 kg.ha^{-1}
22.82	23.93	23.2	22.48	22.1	50 kg .ha^{-1}
LSD A= 0.26	25.47	24.71	23.96	23.37	Average of Ca Nanoparticles effect
	LSD A*B= 0.29				LSD B= 0.21

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5- Carbohydrates percent %:

Table(6)showed significant effect of 25 Kg ha^{-1} rate on Carbohydrates percent %max value(54.04 %) of Cow pea (Vigna unguiculata L.) because decreased plant density in this rate and decreased shading lead to increased numbers of leaves per plant and increased surface area and photosynthesis and increased Carbohydrates percent this conformity with Ahmed et al 2011),also showed significant effect of Ca Nanoparticles on Carbohydrates percent % of Cow pea max value(53.26 %) in treatment 90 ppm because of increased Nano element passed through plasma membrane it is very small size and increased activity of nitrogenase in roots nodules (Shaw and Long 2003) and Novel protein kinases enzymes (Shi et al 1999).and water stress compound like abasic acid (Staxen et al 1999) this conformity with Al-Burki et al 2021) .also showed significant effect of interaction of Ca Nanoparticles and seeds rate max value(56.59 %) in treatment 25 Kg ha^{-1} and 90 ppm because of roles of Ca Nanoparticlesas stimulator nitrogenase(Shaw and Long 2003) and peroxidases and phenylalanine ammonia lyase and phenolic compounds and lignin (Aline et al 2006)also this accepted with Yahya and Karim 2021) the differences between years depend on wind speed which

Table (6) effect of seed rate and Ca Nanoparticles on Carbohydrates percent % in Cow pea at 2020-2021

Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	
54.04	56.59	54.95	53.13	51.5	25 kg.ha^{-1}
47.6	49.92	48.45	46.94	45.8	50 kg .ha^{-1}

increased soil plant atmospheric continuous and increased up take of elements.(**Emmanual 2008).**

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	53.25	51.7	50.04	48.29	Average of Ca Nanoparticles effect
LSD a= 0.43	LSD a*b= 0.35				LSD b= 0.02
effect of seed rate and Ca Nanoparticles on Carbohydrates % in Cow pea at 2021-2022					
Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	
54.91	56.64	55.31	53.81	53.89	25 kg.ha^{-1}
50.72	52.98	51.45	49.93	48.5	50 kg .ha^{-1}
LSD A= 0.21	54.81	53.38	51.87	51.19	Average of Ca Nanoparticles effect
	LSD A*B= 0.59				LSD B= 0.48

6- Fats percent %:

Table(7)showed significant effect of 25 Kg ha-1 rate on Fats percent %max value(1.62 %) of Cow pea (Vigna unguiculata L.) because decreased plant density in this rate and decreased shading lead to increased fat synthesis enzyme lead to increased Fats percent this conformity with Ahmed et al 2011),also showed significant effect of Ca Nanoparticles on Fats percent % of Cow pea max value(1.6 %) in treatment 90 ppm because of increased Nano element passed through plasma membrane it is very small size and increased activity of nitrogenase in roots nodules (Shaw and Long 2003) and Novel protein kinases enzymes (Shi et al 1999).and water stress compound like abasic acid (Staxen et al 1999) this conformity with Al-Burki et al 2021) .also showed significant effect of interaction of Ca Nanoparticles and seeds rate max value(1.69 %) in treatment 25 Kg ha^{-1} and 90 ppm because of roles of Ca Nanoparticles as stimulator nitrogenase(Shaw and Long 2003) and peroxidases and phenylalanine ammonia lyase and phenolic compounds and lignin (Aline et al 2006)also this accepted with Yahya and Karim 2021). the differences between years depend on wind speed which increased soil plant atmospheric continuous and increased up take of elements.(**Emmanual 2008).**

Table (8) effect of seed rate and Ca Nanoparticles **on** Fats % in Cow pea at 2020-2021					
Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	
1.46	1.53	1.48	1.44	1.4	25 kg.ha^{-1}
1.29	1.35	1.31	1.28	1.24	50 kg .ha^{-1}
LSD a = 0..01	1.44	1.4	1.36	1.32	Average of Ca Nanoparticles effect
	LSD a*b= 0.01				LSD b= 0.008
effect of seed rate and Ca Nanoparticles on Fats % in Cow pea at 2021-2022					
Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	

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1.62	1.69	1.64	1.59	1.54	25 kg.ha^{-1}
1.43	1.5	1.45	1.41	1.36	50 kg .ha^{-1}
LSD A= 0.09	1.6	1.55	1.5	1.45	Average of Ca Nanoparticles effect
	LSD A*B= 0.05				LSD B= 0.08

7- Proline :

Table(8)showed significant effect of 25 Kg ha^{-1} rate on Proline max value(2.75) of Cow pea (*Vigna unguiculata* L.) because decreased plant density in this rate and decreased shading lead to increased aeration of soil causes increased alkalinity of soil this good environment to *Rhizobium elkanii* L. (Kadhimyah et al 2020) and increased activity of roots nodules in protein synthesis and all active substances enzymes and the root nodules represent precursor for all amino acid depend on type of organic acid come from Krebs cycle this conformity with Ahmed et al 2011),also showed significant effect of Ca Nanoparticles on Proline of Cow pea max value(3.98) in treatment 90 ppm because of increased Nano element passed through plasma membrane it is very small size and increased activity of nitrogenase in root nodules and active substances enzymes (Shaw and Long 2003) and Novel protein kinases enzymes (Shi et al 1999).and water stress compounds like abasic acid (Staxen et al 1999) this conformity with Al-Burki et al 2021) .also showed significant effect of interaction of Ca Nanoparticles and seeds rate max value(4.16) in treatment 25 Kg ha^{-1} and 90 ppm because of roles of Ca Nanoparticles as stimulator nitrogenase(Shaw and Long 2003) and peroxidases and phenylalanine ammonia lyase and phenolic compounds and lignin (Aline et al 2006)also this accepted with Yahya and Karim 2021) the differences between years depend on wind speed which increased soil plant atmospheric continuous and increased up take of elements.(**Emmanual 2008).**

Table (12) effect of seed rate and Ca Nanoparticles **on** Proline in Cow pea at 2020-2021

Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	
1.46	3.51	3.4	3.3	0.02	25 kg.ha^{-1}
1.29	3.2	3.1	3	0.02	50 kg .ha^{-1}
LSD a = 0..006	3.35	3.25	3.15	0.02	Average of Ca Nanoparticles effect
	LSD a*b= 0.03				LSD b= 0.02

Table (12) effect of seed rate and Ca Nanoparticles on Proline in Cow pea at 2021-2022

Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	
3.03	4.16	4.04	3.91	0.02	25 kg.ha^{-1}
2.76	3.79	3.68	3.57	0.02	50 kg .ha^{-1}

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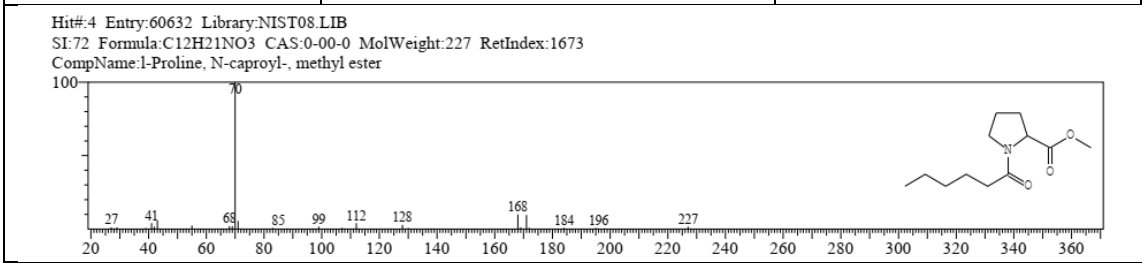
LSD A= 0.009	3.98	3.86	3.74	0.02	Average of Ca Nanoparticles effect
	LSD A*B= 0.03				LSD B= 0.02



8- Ethylamine:

Table(9)showed significant effect of 25 Kg ha^{-1} rate on Ethylamine max value(1.54) of Cow pea (*Vigna unguiculata* L.) because decreased plant density in this rate and decreased shading lead to increased aeration of soil causes increased alkalinity of soil this good environment to *Rhizobium elkanii* L. (Kadhimyah et al 2020) and increased activity of roots nodules in protein synthesis and all active substances enzymes and the root nodules represent precursor for all amino acid depend on type of organic acid come from Krebs cycle this conformity with Ahmed et al 2011),also showed significant effect of Ca Nanoparticles on Ethylamine of Cow pea max value(2.01) in treatment 90 ppm because of increased Nano element passed through plasma membrane it is very small size and increased activity of nitrogenase in root nodules and active substances enzymes (Shaw and Long 2003) and Novel protein kinases enzymes (Shi et al 1999).and water stress compounds like abasic acid (Staxen et al 1999) this conformity with Al-Burki et al 2021) .also showed significant effect of interaction of Ca Nanoparticles and seeds rate max value(2.11) in treatment 25 Kg ha^{-1} and 90 ppm because of roles of Ca Nanoparticles as stimulator nitrogenase(Shaw and Long 2003) and peroxidases and phenylalanine ammonia lyase and phenolic compounds and lignin (Aline et al 2006)also this accepted with Yahya and Karim 2021). the differences between years depend on wind speed which increased soil plant atmospheric continuous and increased up take of elements and stem diameter.(**Emmanual 2008).**

Table (9) effect of seed rate and Ca Nanoparticles **on** Proline in Cow pea at 2020-2021					
Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	
1.37	1.88	1.82	1.76	0.02	25 kg.ha^{-1}
1.25	1.71	1.66	1.61	0.02	50 kg .ha^{-1}
LSD a = 0..007	1.79	1.74	1.68	0.02	Average of Ca Nanoparticles effect
	LSD a*b= 0.018				LSD b= 0.014
effect of seed rate and Ca Nanoparticles on Proline in Cow pea at 2021-2022					
Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate

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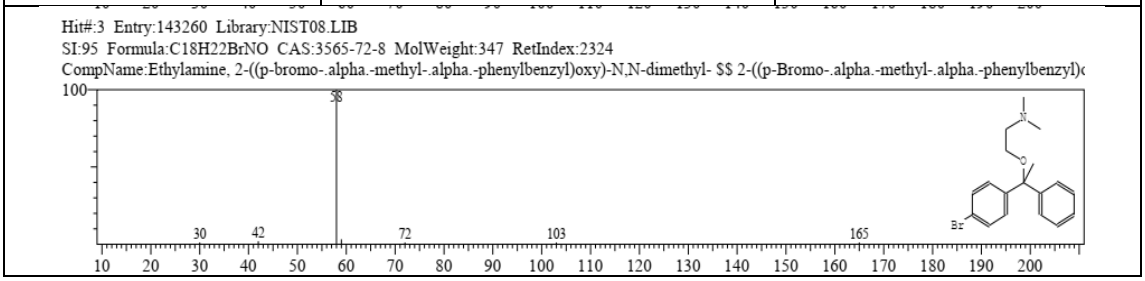
	90	60	30	0	
1.54	2.11	2.05	1.98	0.02	25 kg.ha^{-1}
1.4	1.92	1.86	1.8	0.02	50 kg .ha^{-1}
LSD A= 0.003	2.01	1.95	1.89	0.02	Average of Ca Nanoparticles effect
	LSD A*B= 0.017				LSD B= 0.02



9- Benzenhexanitril:

Table(10)showed significant effect of 25 Kg ha^{-1} rate on Benzenhexanitril max value(0.95) of Cow pea (*Vigna unguiculata* L.) because decreased plant density in this rate and decreased shading lead to increased aeration of soil causes increased alkalinity of soil this good environment to *Rhizobium elkanii* L. (Kadhimyah et al 2020) and increased activity of roots nodules in protein synthesis and all active substances enzymes and the root nodules represent precursor for all amino acid depend on type of organic acid come from Krebs cycle this conformity with Ahmed et al 2011),also showed significant effect of Ca Nanoparticles on Benzenhexanitril of Cow pea max value(1.24 in treatment 90 ppm because of increased Nano element passed through plasma membrane it is very small size and increased activity of nitrogenase in root nodules and active substances enzymes (Shaw and Long 2003) and Novel protein kinases enzymes (Shi et al 1999).and water stress compounds like abasic acid (Staxen et al 1999) this conformity with Al-Burki et al 2021) .also showed significant effect of interaction of Ca Nanoparticles and seeds rate max value(1.3) in treatment 25 Kg ha^{-1} and 90 ppm because of roles of Ca Nanoparticles as stimulator nitrogenase(Shaw and Long 2003) and peroxidases and phenylalanine ammonia lyase and phenolic compounds and lignin (Aline et al 2006)also this accepted with Yahya and Karim 2021). the differences between years depend on wind speed which increased soil plant atmospheric continuous and increased up take of elements.(**Emmanual 2008).**

Table (10) effect of seed rate and Ca Nanoparticles **on** Benzenhexanitril **acid** in Cow pea at 2020-2021

Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	
0.83	1.17	1.1	1.04	0.02	25 kg.ha^{-1}
0.69	0.98	0.92	0.86	0.02	50 kg .ha^{-1}

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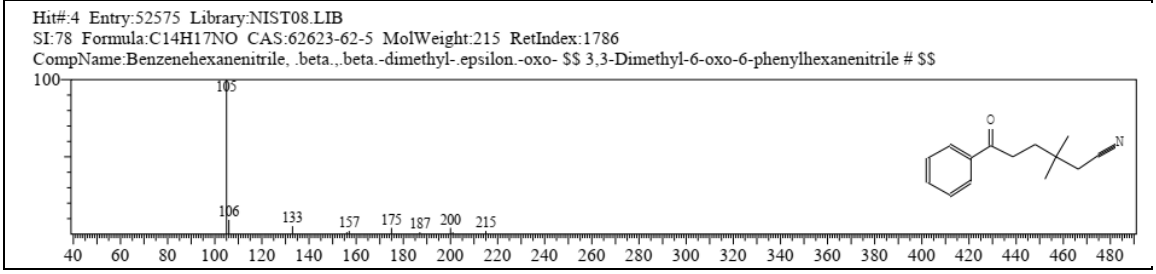
LSD a = 0..006	1.7	1.1	0.95	0.02	Average of Ca Nanoparticles effect
	LSD a*b= 0.01				LSD b= 0.01
effect of seed rate and Ca Nanoparticles on Benzenhexanitril in Cow pea at 2021-2022					
Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	
0.95	1.3	1.26	1.22	0.02	25 kg.ha^{-1}
0.86	1.18	1.15	1.11	0.02	50 kg .ha^{-1}
LSD A= 0.003	1.24	1.2	1.17	0.02	Average of Ca Nanoparticles effect
	LSD A*B= 0.01				LSD B= 0.01



10- Tottal Chlorophyll :

Table(11)showed significant effect of 25 Kg ha^{-1} rate on Total Chlorophyll max value(1.54 mg.g fresh weight) of Cow pea (Vigna unguiculata L.) because decreased plant density in this rate and decreased shading lead to increased sunlight and aeration of soil causes increased alkalinity of soil this good environment to *Rhizobium elkanii* L. (Kadhimyah et al 2020) and increased activity of roots nodules in protein synthesis and all active substances enzymes and the root nodules represent precursor for all amino acid depend on type of organic acid come from Krebs cycle this conformity with Ahmed et al 2011),also showed significant effect of Ca Nanoparticles on total Chlorophyll of Cow pea max value(1.54) in treatment 90 ppm because of increased Nano element passed through plasma membrane it is very small size and increased activity of nitrogenase in root nodules and active substances enzymes (Shaw and Long 2003) and Novel protein kinases enzymes (Shi et al 1999).and water stress compounds like abasic acid (Staxen et al 1999) this conformity with Al-Burki et al 2021).also showed significant effect of interaction of Ca Nanoparticles and seeds rate max value(1.62) in treatment 25 Kg ha^{-1} and 90 ppm because of roles of Ca Nanoparticlesas stimulator nitrogenase(Shaw and Long 2003) and peroxidases and phenylalanine ammonia lyase and phenolic compounds and lignin (Aline et al 2006)also this accepted with Yahya and Karim 2021). the differences between years depend on wind speed which increased soil plant atmospheric continuous and increased up take of elements and stem diameter .(**Emmanual 2008).**

Table (11) effect of seed rate and Ca Nanoparticles on Total chlorophyll Mg.g^{-1} fresh weight in Cow pea at 2020-2021		
Average seed rate effect	Levels of Ca Nanoparticles ppm	Seeds rate

University of Thi-Qar Journal of agricultural research

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	90	60	30	0	
1.46	1.49	1.49	1.43	1.8	25 kg.ha^{-1}
1.29	1.4	1.37	1.34	1.55	50 kg .ha^{-1}
LSD a = 0..03	1.44	1.43	1.38	1.67	Average of Ca Nanoparticles effect
	LSD a*b= 0.03				LSD b= 0.02

effect of seed rate and Ca Nanoparticles on Total chlorophyll Mg.g^{-1} fresh weight in Cow pea at 2021-2022

Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	
1.54	1.62	1.57	1.52	1.47	25 kg.ha^{-1}
1.36	1.43	1.39	1.34	1.3	50 kg .ha^{-1}
LSD A= 0.01	1.52	1.48	1.43	1.39	Average of Ca Nanoparticles effect
	LSD A*B= 0.01				LSD B= 0.004

10- Grain yield(Ton ha^{-1}):

Table(12)showed significant effect of 25 Kg ha-1 rate on Grain yield(Ton ha^{-1})max value(2.6) of Cow pea (Vigna unguiculata L.) because decreased plant density in this rate and decreased shading lead to increased sunlight and aeration of soil causes increased alkalinity of soil this good environment to *Rhizobium elkanii* L. (Kadhimyah et al 2020) and increased activity of roots nodules in protein synthesis and all active substances enzymes and the root nodules represent precursor for all amino acid depend on type of organic acid come from Krebs cycle this conformity with Ahmed et al 2011),also showed significant effect of Ca Nanoparticles on Grain yield(Ton ha^{-1})of Cow pea max value(2.56) in treatment 90 ppm because of increased Nano element passed through plasma membrane it is very small size and increased activity of nitrogenase in root nodules and active substances enzymes (Shaw and Long 2003) and Novel protein kinases enzymes (Shi et al 1999).and water stress compounds like abasic acid (Staxen et al 1999) this conformity with Al-Burki et al 2021) .also showed significant effect of interaction of Ca Nanoparticles and seeds rate max value(2.72) in treatment 25 Kg ha^{-1} and 90 ppm because of roles of Ca Nanoparticles as stimulator nitrogenase(Shaw and Long 2003) and peroxidases and phenylalanine ammonia lyase and phenolic compounds and lignin (Aline et al 2006)also this accepted with Yahya and Karim 2021) the differences between years depend on wind speed which increased soil plant atmospheric continuous and increased up take of elements and stem diameter.(Emmanual 2008).

Table (12) effect of seed rate and Ca Nanoparticles on grain yield Ton ha^{-1} in Cow pea at 2020-2021

Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	
2.23	2.27	2.2	2.11	2.37	25 kg.ha^{-1}
1.95	2.02	1.97	1.93	1.9	50 kg .ha^{-1}

University of Thi-Qar Journal of agricultural research

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LSD a= 0.33	2.14	2.08	2.02	2.13	Average of Ca Nanoparticles effect
	LSD a*b= 0.32				LSD b= 0.22
effect of seed rate and Ca Nanoparticles on grain yield Ton ha^{-1} in Cow pea at 2021-2022					
Average seed rate effect	Levels of Ca Nanoparticles ppm				Seeds rate
	90	60	30	0	
2.6	2.72	2.63	2.55	2.49	25 $kg.ha^{-1}$
2.29	2.4	2.33	2.25	2.19	50 $kg.ha^{-1}$
LSD A= 0.006	2.56	2.48	2.4	2.34	Average of Ca Nanoparticles effect
	LSD A*B= 0.01				LSD B= 0.01

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