



Response of green pea(*Pisum sativum*) to Foliar spray of CuO Nanoparticles and number of spraying

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Abstract

Experiment conducted at winter season 2022-2023 at plastic boxes on clay sandy soil in Al-Diwanyia. The experiment was design as CRBD with three replications arranged for split-pilot design, in $LSD_{0.05}$ the main treatment contend two groups one spray(after 25 days of sowing) and two spray(after 25 and 50 day of sowing) within there four levels of CuO Nanoparticles(0 , 50 , 100 , 200) PPM. I was took sample of soil before planting to analysis it and to learn physical and chemical properties in table (1). Green pea(*Pisum sativum* L.) were sowing at rate $25 \text{ kg} \cdot \text{ha}^{-1}$ (3 cm depth of sowing) at $1/9$, after 5 months I took a samples to measure . The results showed all factors and interactions were significant effect and increased all growth traits (plant content of protein , carbohydrate total Chlorophyll and fats and active substances ,) lead to increased grain yield max values ($1.58 \text{ Ton} \cdot \text{ha}^{-1}$) at interaction of two spray and 200PPM Cu O Nanoparticles level, while min vaule($1.39 \text{ Ton} \cdot \text{ha}^{-1}$) at interaction one spray and 0 ppm Cu O Nanoparticles level.

Keywords : two spray ,Foliar spray, , Green pea ,Cu O Nanoparticles

Introduction:

Green pea contains 24.7% protein ,2.6% fat , 0.9% fiber and 3.7% ash (Andrzej et al 2023). also one of the medicinal plants (Duke et al 2002 Runchana and

Wanee 2017) also Bioremedater because ability to remove heavy metals like Cadmium from soil. (Burd et al 2000 ; Andrzej et al 2023) We

must applicant modern methods increased yield of Green pea by uses Nano chelating fertilizer because its ecofriendly and slow released . Foliar spray of CuO Nanoparticles (50 PPM) increased number of branches of broad bean.(Kahlel et al 2020)..Foliar application of CuO Nanoparticles on Lettuce will increased Fe concentration 80% and alleviated Cd and Pb (Sharifan et al 2019). Application of Cu enhance root growth and nitrogen fixation.(Vadlamudi et al 2020)..also oxido-reduction reaction in addition to maintaining the structure and functional integrity of biological membranes .(Kolencik et al 2022) .CuO Nano particles increased activity of enzymes phosphatase and phytase 84% and 108% . (Raliya et al 2016) , Cuo Nanoparticles increased root and shoot growth of seedling Green pea in the 20 PPM concentration while 1 PPM concentration in Chickpea. (Mahajan et al 2011).Foliar spray of iron Nanoparticles in three concentration (1 , 2, ,3,) g.l⁻¹ in three growth stages during stem

elongation and flowering and harvest they reported that highest flower yield and essential oil percentage where achieved when 1 g.l⁻¹ of iron Nanoparticles was applied at stem elongation stage. (Amuamuha and Hashem (2012)

Material and methods:

All treatments fertilized with 20 kg.ha⁻¹ Urea_{(47)nitrogen} to stimulate *nif* H gene it responsible on nitrogenase formation(Xuan et al 2017). Add 10ml of on seeds powder methanol_(100%) and mixing at 10min.Then store at 6h in dark place then filtered by 4.5μ and Iam add 1ml then analysis by GC- hexane_(100%) 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). Rhizobium laguerreae L culture's prepare from crushed sterile old root nodule with one drop of distal water then incubated at 30 °C for 3-7 days(; Jose et al 2020 other measures (AOAC2000)

Tabl(1) showed analydis of soil before planting

Soil		
Value	Unite	Properties
7.54	-----	Soil PH
93.5	(μS/cm)	Electrical conductivity
4.54	g.kg ⁻¹ of soil	Organic matter

73.23	mg.kg ⁻¹ of soil	A voluble nitrogen
41.2		A voluble phosphor
35		A voluble potassium
283	g.kg ⁻¹ of soil	Sand
165.4		Silt
743.8		Clay
Sandy – clay soil		Texture

Results and Discussion:

1- Protein percent %:

Table(2) showed significant effect of two spray on protein percent% max value(23.082%) of Green pea because these 25 day of sowing represented stage of vegetative stage development while 50 day of sowing spray represent flower development stage this accepted (Xuan et al 2017) ,also showed significant effect of CuO Nanoparticles on protein percent of Green pea max value(22.48%) in treatment 200 PPM because of increased Nano

element passed through plasma membrane it is very small size and increased activity of enzymes which responsible on protein synthesis this accepted ; Haifaa and Homayoun 2016 ; Al-Burki et al 2021 Kolencik et al 2022) .also showed significant effect of interaction of CuO Nanoparticles and two spray max value(24.37%) in two spray and 200ppm because of roles of CuO Nanoparticles as stimulator to photosynthetic electron transport photosystem II and nitrogenase enzymes this accepted : Daniel et al 2020 ; Shah et al 2021),

Average number of spray. effect	Levels of CuO Nanoparticles PPM				Number of spray
	200	100	50	0	
23.082	24.37	23.65	22.63	21.67	Two spray
19.101	20.6	19.58	18.62	17.59	One spray
	22.48	21.618	20.628	19.63	Average of CuO Nanoparticles effect
LSD a = 0.204	LSD a*b= 0.179			LSD b= 0.116	

2- Carbohydrates percent %:

Average number of spray effect	Levels of CuO Nanoparticles PPM				Number of spray
	200	100	50	0	
56.33	61.6	56.07	56.67	53.89	Two spray
52.31	51.06	48.54	46.47	44.33	One spray

	56.33	52.31	51.57	49.11	Average of CuO Nanoparticle effect
LSD a= 3.7	LSD a*b= 3.79			LSD b= 2.69	

Table(3) showed significant effect of two spray on Carbohydrates percent% max value(56.33%) of Green pea because these 25 day of sowing represented stage of vegetative stage development while 50 day of sowing spray represent flower development stage also increased activity of photosynthesis because of increased total chlorophyll in leaves this accepted Xuan et al 2017 ,also showed significant effect of CuO Nanoparticles on Carbohydrates percent of Green pea max value(56.33%) in treatment 200ppm 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 accepted ; Haifaa and Homayoun 2016 ; Al-Burki et al 2021 Kolencik et al 2022) .also showed significant effect of interaction of CuO Nanoparticles and two spray max value(61.6%) in two spray and 200ppm because of roles of CuO Nanoparticles as stimulator to photosynthetic electron transport photosystem II and nitrogenase enzymes this accepted : Daniel et al 2020 ; Shah et al 2021),

3- Fats percent %:

Table(4) showed significant effect of two spray on Fats percent% max value(2.54%) of Green pea because these 25 day of sowing represented stage of vegetative development while 50 day of sowing spray represent flower development stage also increased precursor of Fats synthesis enzymes and root nodules provided all types of amino acids depend on type of organic acids come from Krebs cycle this accepted ;(Khalif and Mohammed 2018) ,also showed significant effect of CuO Nanoparticles on Fats percent of Green pea max value(2.5%) in treatment 200ppm 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 accepted ; Al-Burki et al 2021.also showed significant effect of interaction of CuO Nanoparticles and two spray max value(2.71%) in two spray and 200 ppm because of roles of CuO Nanoparticles as stimulator to Fats synthesis and nitrogenase enzymes this accepted : Daniel et al 2020 ; Shah et al 2021). Shah et al 2021),

Average number of spray effect	Levels of CuO Nanoparticles ppm				soil
	200	100	50	0	
2.54	2.71	2,6	2.49	2.39	Two spray
2.15	2.3	2.21	2.1	2	One spray
	2.5	2.4	2.29	2.19	Average of CuO Nanoparticles effect
LSD a=0.02.	LSD a*b= 0.01			LSD b= 0.01	

4- 1,Propanamine :

Table(5)showed significant effect of two spray on 1,Propanamine max value(1.65) of Green pea because increased precursor of active substances synthesis enzymes and root nodules provided all types of amino acids depend on type of organic acid come from Krebs cycle this

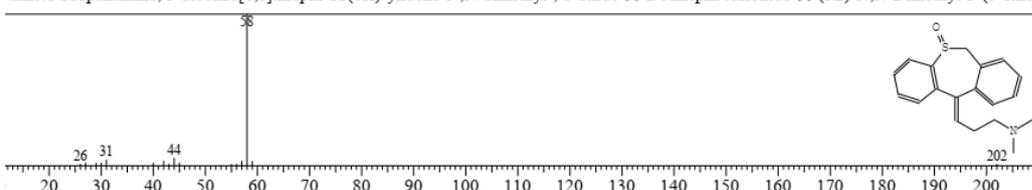
accepted ; Khalif and Mohammed 2018 ,also showed significant effect of CuO Nanoparticles on 1,Propanamine of Green pea max value(2.16) in treatment two spray because of increased Nano element (during these two stage of growth development) passed through plasma membrane it is very small

Average of Number of spray effect	Levels of CuO Nanoparticles ppm				Number of spray
	200	100	50	0	
1.65	2.26	2.19	2.13	0.02	Two spray
1.51	2.06	2.01	1.96	0.02	One spray
	2.16	2.1	2.04	0.02	Average of CuO Nanoparticles effect
LSD a= 0.01	LSD a*b= 0.025			LSD b= 0.02	

Entry:119774 Library:NIST08.LIB

Formula:C19H21NOS CAS:1447-71-8 MolWeight:311 RetIndex:0

Name:1-Propanamine, 3-dibenzo[b,e]thiepin-11(6H)-ylidene-N,N-dimethyl-, S-oxide SS Dothiepin sulfoxide SS (3E)-N,N-Dimethyl-3-(5-oxido



size and increased activity of enzymes this accepted ; Al-Burki et al (2021) .also showed significant effect of interaction of CuO Nanoparticles and two spray on 1,Propanamine max value(2.26) in two spray and 200 PPM because of roles of CuO Nanoparticles as stimulator to active substances synthesis and nitrogenase enzymes this accepted: Daniel et al (2020 ; Shah et al 2021),

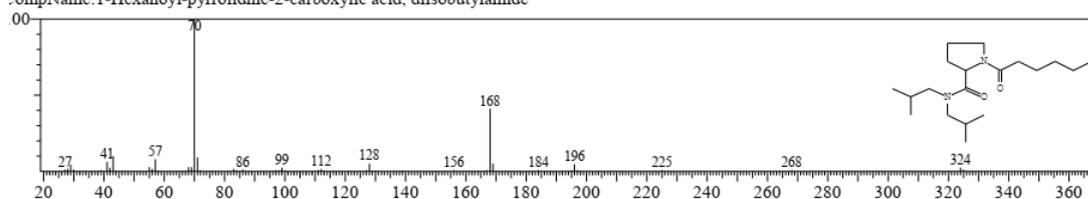
5- 1- Hexanol.pyrrolidine:

Table (6) effect of Foliar spray of CuO Nanoparticles and number of spraying on 1- Hexanol.pyrrolidine in Green pea

Table(6)showed significant effect of two spray on 1-Hexanol.pyrrolidinemax max. value(2.24) of Green pea because increased precursor of active substances synthesis enzymes in in root nodules provided all types of amino acids depend on type of organic acids come from Krebs cycle this accepted ;(Khalif and Mohammed 2018) ,also showed significant effect of CuO Nanoparticles on 1-Hexanol.pyrrolidine of Green pea max value(2.92) in treatment two spray 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 accepted ;(Al-Burki et al 2021.) also showed significant effect of interaction of 200ppm CuO Nanoparticles and two spray on 1- Hexanol.pyrrolidine max value(3.06) in two spray and 200PPM because of roles of CuO Nanoparticles as stimulator to active substances synthesis and nitrogenase enzymes this accepted : Daniel et al 2020 ; Shah et al 2021),

Average number of spray effect	Levels of CuO Nanoparticles PPM				Number of spray
	200	100	50	0	
2.24	3.06	2.99	2.88	0.02	Two spray
2.02	2.79	2.69	2.59	0.02	One spray
	2.92	2.84	2.73	0.02	Average of CuO Nanoparticles effect
LSD a= 0.01	LSD a*b= 0.02			LSD b= 0.02	

Hit#:1 Entry:128640 Library:NIST08.LIB
 iL:79 Formula:C19H36N2O2 CAS:0-00-0 MolWeight:324 RetIndex:2275
 CompName:1-Hexanoyl-pyrrolidine-2-carboxylic acid, diisobutylamide



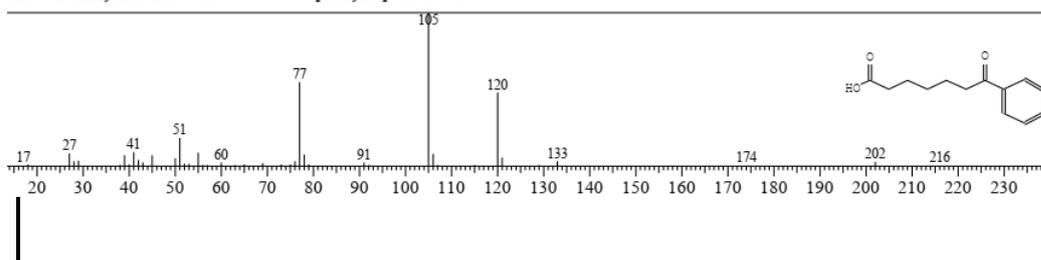
6- 6- Benzenohexonic acid ::
 Table(7)showed significant effect of two spray on 6- Benzenohexonic acid max value(2.02) of Green pea because increased precursor of active substances synthesis enzymes in roots nodules provided all types of amino acids depend on type of organic acid come from Krebs cycle this accepted ;(Khalif and Mohammed 2018) ,also showed significant effect of CuO Nanoparticles on 6- Benzenohexonic acid of Green pea max value(1.99) in treatment two spray 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 accepted ;(Al-Burki et al 2021).also showed significant effect of interaction of CuO Nanoparticles and two spray on 6- Benzenohexonic acid max value(2.07) in two spray and 200PPM because of roles of CuO Nanoparticles as stimulator to active substances synthesis and nitrogenase enzymes this accepted: Daniel et al 2020 ; Shah et al 2021),

Table (7) effect of Foliar spray of CuO Nanoparticles and number of spraying on 6- Benzenohexonic acid in Green pea

Average number of spray effect	Levels of CuO Nanoparticles PPM				Number of spray
	200	100	50	0	
1.51	2.07	2	1.95	0.02	Two spray
1.38	1.91	1.85	1.77	0.02	One spray
	1.99	1.92	1.86	0.02	Average of CuO Nanoparticles effect
LSD a= 0.006	LSD a*b= 0.02			LSD b= 0.01	

Entry:55677 Library:NIST08.LIB
 formula:C13H16O3 CAS:7472-43-7 MolWeight:220 RetIndex:1882
 name:6-Benzoylhexanoic acid 7-Oxo-7-phenylheptanoic acid # 55



7- Total Chlorophyll :

Table(8) showed significant effect of two spray on Total Chlorophyll max value(2.42) of Green pea because increased photosynthesis enzymes in these two stage of growth and root nodules represent precursor of active substances synthesis enzymes in nodules provided all types of amino acids depend on type of organic acids come from Krebs cycle this accepted ; (Khalif and Mohammed 2018) ,also showed significant effect of CuO Nanoparticles on Total Chlorophyll Mg.g^{-1} fresh weight of Green pea max value(2.38) in

treatment two spray 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 enzymes this accepted ;(Al-Burki et al 2021).also showed significant effect of interaction of CuO Nanoparticles and two spray on Total Chlorophyll max value(2.59) in two spray and 200ppm because of roles of CuO Nanoparticles as stimulator to active substances synthesis and nitrogenase enzymes this accepted ; Daniel et al 2020 ; Shah et al 2021),

Average number of spraying effect	Levels of CuO Nanoparticles PPM				Number of spray
	200	100	50	0	
2.42	2.59	2.48	2.37	2.26	Two spray
2.11	2.16	2.08	2.32	1.39	One spray
	2.38	2.28	2.34	2.08	Average of CuO Nanoparticles effect
LSD a= 0.36	LSD a*b= 0.36			LSD b= 0.25	

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

Table(9) showed significant effect of two spray on Grain yield max value(2.42) Ton ha^{-1} of Green pea because increased precursor of active substances synthesis enzymes in root nodules provided all types of amino acids depend on type of

organic acids come from Krebs cycle this accepted ; (Khalif and Mohammed 2018) ,also showed significant effect of CuO Nanoparticles on Grain yield of Green pea max value(2.16) Ton ha^{-1} in treatment two spray 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 accepted (Al-Burki et al 2021) .also showed significant effect of interaction of CuO Nanoparticles and two spray on Grain yield

max value(2.59) Ton ha⁻¹ in two spray and 200ppm because of roles of CuO Nanoparticles as stimulator to active substances synthesis and nitrogenase enzymes this accepted Daniel et al 2020 ; Shah et al 2021),

Table (9) effect of Foliar spray of CuO Nanoparticles and number of spraying on grain yield Ton ha ⁻¹ in Green pea					
Average number of spray effect	Levels of CuO Nanoparticles PPM				Number of spray
	200	100	50	0	
1.51	1.58	1.52	1.49	1.47	Two spray
1.42	1.45	1.43	1.41	1.39	One spray
	1.51	1.48	1.45	1.43	Average of CuO Nanoparticles effect
LSD a= 0.01	LSD a*b= 0.01			LSD b= 0.008	

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