

# Response of Mung Bean (*Vigna radita* L.) to Fungal Inoculation (*Glomus mosseae* L. ) and Nano Chelating Zn Fertigation

Mohammed Swadi Zagher Al-Rkabe

Ministry of Education, Al-Rahman School, Babil, Iraq.

E-mail: mohammed.swadi@qu.edu.iq

**Abstract.** Field experiment conducted at winter season 2022-2023 on clay sandy soil in Al-Diwanyia. The experiment was design as CRBD with three replications arranged for split-pilot design, in lest significant differences (  $LSD_{0.05}$  )the main treatment contend two groups inoculation and non inoculation within there four levels of Nano Zn ( 0 , 1 , 2 , 3 )  $g.L^{-1}$ . I took sample of soil before planting to analysis it and to learn physical and chemical traits. Mung bean were sowing at rate  $20 kg.ha^{-1}$  (3cm depth) at 1/9 , after 5 months I took a sample to measure . The results showed all factors and interactions were significant effect and increased all growth traits (plant content of protein , carbohydrates total Chlorophyll and fats,) lead to increased grain yield max values ( $8.2 Ton.ha^{-1}$ ) at interaction of *Glomus mosseae* e inoculation and 3  $g.L^{-1}$  Nano Zn level, while min value ( $5.81 Ton.ha^{-1}$ ) at interaction no inoculation and 0  $g.L^{-1}$  Nano Zn level.

**Keywords.** Inoculation, *Glomus*, Fertigation, Mung bean, Nano Zn.

## 1. Introduction

Mung bean one of main sources of protein to 75% of people word [1]. Also one of the medicinal plants [2], also Bio remedater because ability to remove heavy metals like Cadmium from soil.[3] Inoculation wheat by *Glomus mosseae* e L. lead to increased seeds yield and phosphorus content under normal irrigation [4]. Arbuscular mycorrhzia increased dry matter Iron monosulphate fatty acids [5]. Foliar spray of ZnO Nanoparticles on Lentil increased yield and increased stress tolerance of same plant [6]. Nano Zinc oxide good fertilizer because ecofriendly in slow release and increased Mung bean resistances to abiotic stress [7].

## 2. Material and Methods

Inoculated Seeds of Mung bean imbibition in *Glomus mossese* L. solution so as to inoculate[8] All treatments fertilized with  $20 kg.ha^{-1}$  Urea 47% N to stimulate *nif* H gene it responsible on nitrogenase formation.[9] Iam add 10 ml of methanol (100%) on seeds powder and mixing at 10 min .Then store at 6h in dark place then filtered  $4.5\mu$  and Iam add 1 ml 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 sexhlet .While analysis of carbohydrates depend on [10].*Rhizobium phaseoli* L cultures prepare from crushed sterile old root nodule with one drop of distal water then incubated at 30 °C to 3-7 days all seeds imbibition in Rhizobium solution so as to stimulate bio fertilizer [11] other measures [12].

**Table 1.** Showed analysis of soil before planting.

Soil		
Properties	Unite	Value
Soil PH	-----	7.28
Electrical conductivity	( $\mu\text{S}/\text{cm}$ )	94.5
Organic matter	$\text{g.kg}^{-1}$ of soil	4.28
A voluble nitrogen		73.54
A voluble phosphor	$\text{mg.kg}^{-1}$ of soil	41.5
A voluble potassium		58
Sand		403.6
Silt	$\text{g.kg}^{-1}$ of soil	189.5
Clay		764.8
Texture	Sandy – clay soil	

### 3. Results and Discussion

#### 3.1. Protein Percent %

Table (2) showed significant effect of inoculation on protein percent% max value(28.207%) of Mung bean because increased Mycorrhzia on root and nodules which responsible on nitrogen fixation this accepted [5,13] ,also showed significant effect of Nano Zn fertilizers on protein percent of Mung bean, max value(27.387%) in treatment 3  $\text{g.l}^{-1}$  because of increased Nano element passed through plasma membrane it is very small size and increased activity of enzymes which responsible on protein synthesis this accepted [5,14,21].also showed significant effect of interaction of Nano Zn and inoculation max value(30.823%) in inoculation and 3  $\text{g.l}^{-1}$  because of roles of Nano Zn as stimulator to photosynthesis and nitrogenase enzymes this accepted with [4,7,15].

**Table 2.** Effect of inoculation with *Glomus mosseae* and Nano Zn on protein % in Mung bean.

Inoculation with <i>Glomus</i>	Levels of Nano Zn $\text{gramL}^{-1}$				Average inocu. effect
	0	1	2	3	
Inoculated seeds	25.697	27.3	29.,007	30.823	28.207
Non Inoculated seeds	20.573	21.86	23.197	23.95	22.395
Average of Nano Zn effect	23..135	24.85	26.102	27..387	
	LSD b= 0.197		LSD a*b= 0.25		LSD a = 0.151

#### 3.2. Carbohydrates Percent %

Table (3) showed significant effect of inoculation on carbohydrates percent% max value(49.078%) of Mung bean because increased precursor of photosynthesis enzymes and mycorrhzial and root nodules provided all types of amino acids depend on type of organic acids come from Krebs cycles this accepted with [5,16] ,also showed significant effect of Nano Zn fertilizers on carbohydrates percent of Mung bean max value(47.84%) in treatment 3  $\text{g.l}^{-1}$  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 accepted with [5,14].also showed significant effect of interaction of Nano Zn and inoculation max value(53.62%) in inoculation and 3  $\text{g.l}^{-1}$  because of roles of Nano Zn as stimulator to photosynthesis and nitrogenase enzymes this accepted with [4,7,15].

**Table 3.** Effect of inoculation with *Glomus mosseae* and Nano Zn on carbohydrate % in Mung bean.

Inoculation with <i>Glomus mosseae</i>	Levels of Nano Zn $\text{gramL}^{-1}$				Average inocu. effect
	0	1	2	3	
Inoculated seeds	44.7	45.497	50.467	53.62	49.072
Non Inoculated seeds	35.07	37..273	39.597	42.07	38.5
Average of Nano Zn effect	39..89	42.385	45.032	47.848	
	LSD b= 0.08		LSD a*b= 0.45		LSD a= 0.531

### 3.3. Fats Percent %

Table (4) showed significant effect of inoculation on Fats percent% max value (2%) of Mung bean because increased precursor of Fats synthesis enzymes in mycorrhizal and root nodules provided all types of amino acids depend on type of organic acids come from Krebs cycle this accepted with [5] [16] ,also showed significant effect of Nano Zn fertilizers on Fats percent of Mung bean, max value(1.97%) in treatment 3 g.l<sup>-1</sup> 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 with [5,14].also showed significant effect of interaction of Nano Zn and inoculation max value(2.0937%) in inoculation and 3 g.l<sup>-1</sup> because of roles of Nano Zn as stimulator to Fats synthesis and nitrogenase enzymes this accepted with [4,7,15].

**Table 4.** Effect of inoculation with *Glomus mosseae* and Nano Zn on Fats % in Mung bean.

Inoculation with <i>Glomus mosseae</i>	Levels of Nano Zn gramL <sup>-1</sup>				Average inocu. effect
	0	1	2	3	
Inoculated seeds	1.91	1.979	2.03	2.093	2
Non Inoculated seeds	1.693	1.743	1.8	1.85	1.77
Average of Nano Zn effect	1.801	1.861	1.915	1.97	LSD a=0.003.
	LSD b= 0.003		LSD a*b= 0.01		

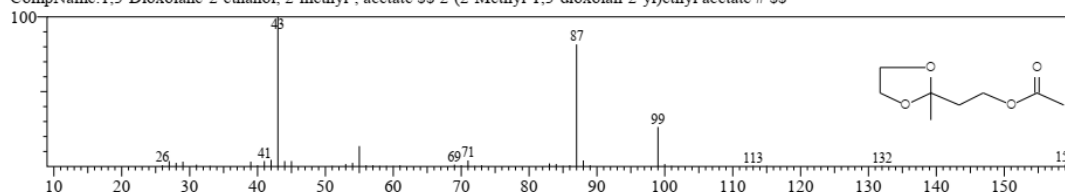
### 3.4. 1,3 Dioxolane

Table (5) showed significant effect of inoculation on 1,3 Dioxolane max value(3.75) of Mung bean because increased precursor of active substances synthesis enzymes in mycorrhizal and root nodules provided all types of amino acids depend on type of organic acids come from Krebs cycle this accepted with [5] ; [16] ,also showed significant effect of Nano Zn fertilizers on 1,3 Dioxolane of Mung bean(*Vigna radita* L.), max value(4.93) in treatment 3 g.l<sup>-1</sup> 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 with [5,14] also showed significant effect of interaction of Nano Zn and inoculation on 1,3 Dioxolane max value(5.15) in inoculation and 3 g.l<sup>-1</sup> because of roles of Nano Zn as stimulator to active substances synthesis and nitrogenase enzymes this accepted with [4,7,15].

**Table 5.** Effect of inoculation with *Glomus mosseae* and Nano Zn on 1,3 Dioxolane in Mung bean.

Inoculation with <i>Glomus mosseae</i>	Levels of Nano Zn gram.L <sup>-1</sup>				Average inocu. effect
	0	1	2	3	
Inoculated seeds	0.02	4.83	4.99	5.15	3.75
Non Inoculated seeds	0.02	4.4	4.58	4.7	3.42
Average of Nano Zn effect	0.02	4.61	4.78	4.93	LSD a= 0.06
	LSD b= 0.04		LSD a*b= 0.06		

Hit#:3 Entry:27399 Library:NIST08.LIB  
 SI:74 Formula:C8H14O4 CAS:68039-72-5 MolWeight:174 RetIndex:1178  
 CompName:1,3-Dioxolane-2-ethanol, 2-methyl-, acetate SS 2-(2-Methyl-1,3-dioxolan-2-yl)ethyl acetate # SS



### 3.5. Proline

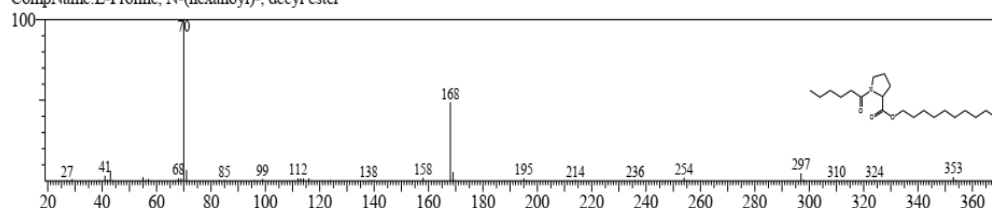
Table (6) showed significant effect of inoculation on Proline max value(1.37) of Mung bean because increased precursor of active substances synthesis enzymes in mycorrhizal and root nodules provided all types of amino acids depend on type of organic acids come from Krebs cycle this accepted with [5,16,20], also showed significant effect of Nano Zn fertilizers on Proline of Mung bean, max value(1.79) in treatment 3 g.l<sup>-1</sup> 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 with [5,14].also showed significant effect of interaction of Nano Zn and

inoculation on Proline max value(1.87) in inoculation and 3 g.<sup>-1</sup> because of roles of Nano Zn as stimulator to active substances synthesis and nitrogenase enzymes this accepted with [4,7,15].

**Table 6.** Effect of inoculation with *Glomus mosseae* and Nano Zn on Proline in Mung bean.

Inoculation with <i>Glomus mosseae</i>	Levels of Nano Zn gramL <sup>-1</sup>				Average inocu. effect
	0	1	2	3	
Inoculated seeds	0.02	1.76	1.82	1.87	1.37
Non Inoculated seeds	0.02	1.61	1.66	1.71	1.25
Average of Nano Zn effect	0.02	1.68	1.74	1.79	
	LSD b= 0.01		LSD a*b= 0.01		LSDa=0.004

Hit#:3 Entry:146675 Library:NIST08.LIB  
 SI:72 Formula:C21H39NO3 CAS:0-00-0 MolWeight:353 RetIndex:2568  
 CompName:L-Proline, N-(hexanoyl)-, decyl ester



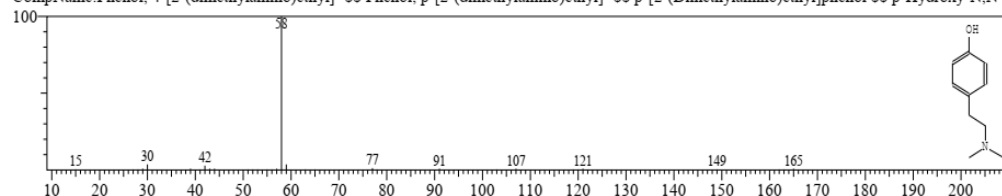
### 3.6. Phenol

Table (7) showed significant effect of inoculation on Phenol max value(2.092) of Mung bean because increased precursor of active substances synthesis enzymes in mycorrhizal and roots nodules provided all types of amino acids depend on type of organic acids come from Krebs cycle this accepted with [5,16], also showed significant effect of Nano Zn fertilizers on Phenol of Mung bean max value(2.742) in treatment 3 g.l<sup>-1</sup> 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 with [5,14], also showed significant effect of interaction of Nano Zn and inoculation on Phenol max value(2.87) in inoculation and 3 g.<sup>-1</sup> because of roles of Nano Zn as stimulator to active substances synthesis and nitrogenase enzymes this accepted with [7,15,19].

**Table 7.** Effect of inoculation with *Glomus mosseae* and Nano Zn on Phenol in Mung bean.

Inoculation with <i>Glomus mosseae</i>	Levels of Nano Zn gramL <sup>-1</sup>				Average inocu. effect
	0	1	2	3	
Inoculated seeds	0.02	2.696	2.782	2.87	2.092
Non Inoculated seeds	0.02	2.424	2.511	2.613	1.892
Average of Nano Zn effect	0.02	2.56	2.646	2.742	
	LSD b= 0.02		LSD a*b= 0.02		LSD a= 0.02

Hit#:4 Entry:22576 Library:NIST08.LIB  
 SI:90 Formula:C10H15NO CAS:539-15-1 MolWeight:165 RetIndex:1362  
 CompName:Phenol, 4-[2-(dimethylamino)ethyl]-; Phenol, p-[2-(dimethylamino)ethyl]-; p-[2-(Dimethylamino)ethyl]phenol; p-Hydroxy-N,N-di



### 3.7. Total Chlorophyll

Table (8) showed significant effect of inoculation on Total Chlorophyll max value(2.713 mg.g<sup>-1</sup> fresh weight) of Mung bean because increased precursor of active substances synthesis enzymes in mycorrhizal and roots nodules provided all types of amino acids depend on type of organic acids come from Krebs cycle this accepted with [5,16], also showed significant effect of Nano Zn fertilizers on Total Chlorophyll of Mung bean max value(2.67 mg.g<sup>-1</sup> fresh weight) in treatment 3 g.l<sup>-1</sup> 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 with [5,14].also showed significant effect of interaction of Nano Zn and inoculation on Total Chlorophyll max value(2.92

mg.g<sup>-1</sup> fresh weight) in inoculation and 3 g.l<sup>-1</sup> because of roles of Nano Zn as stimulator to active substances synthesis and nitrogenase enzymes this accepted [4,15,18,7].

**Table 8.** Effect of inoculation with *Glomus mosseae* and Nano Zn on total chlorophyll mg.g<sup>-1</sup> fresh weight in Mung bean.

Inoculation with <i>Glomus</i>	Levels of Nano Zn gramL <sup>-1</sup>				Average inocu. effect
	0	1	2	3	
Inoculated seeds	2.536	2.653	2.,743	2.92	2.713
Non Inoculated seeds	2.103	2.196	2.296	2.42	2.254
Average of Nano Zn effect	2..32	2.425	2.52	2..67	LSD a = 0.013
LSD b= 0.012	LSD a*b= 0.016				

### 3.8. Grain yield (Ton ha<sup>-1</sup>)

Table (9) showed significant effect of inoculation on Grain yield max value(7.51) Ton ha<sup>-1</sup> of Mung bean because increased precursor of active substances synthesis enzymes in mycorrhizal and root nodules provided all types of amino acids depend on type of organic acids come from Krebs cycle this accepted with [5,16] ,also showed significant effect of Nano Zn fertilizers on Grain yield of Mung bean max value(7.426) Ton ha<sup>-1</sup> in treatment 3 g.l<sup>-1</sup> 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 with [5,14].also showed significant effect of interaction of Nano Zn and inoculation on Grain yield max value(8.2) Ton ha<sup>-1</sup> in inoculation and 3 g.l<sup>-1</sup> because of roles of Nano Zn as stimulator to active substances synthesis and nitrogenase enzymes this accepted with [4,7,15,17].

**Table 8.** Effect of inoculation with *Glomus mosseae* and Nano Zn on grain yield Ton h-1 in Mung bean.

Glomus mosseae Inoculation	Levels of Nano Zn gram l <sup>-1</sup>				Average inocu. effect
	0	1	2	3	
Inoculated seeds	6.973	7.283	7.,58	8.2	7.51
Non Inoculated seeds	5.81	6.07	6.393	6.65	6.231
Average of Nano Zn effect	6..392	6.677	6.987	7.426	LSD a= 0.12
LSD b= 0.06	LSD a*b= 0.1				

### Conclusion

Inoculation of *Glomus mosseae* has good roles to Mung bean because symposia relationship by provided Mung bean by elements also Chelating Nano Zn slow release and increased surface area for all biological proses in Mung bean.

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