Chickpea production and the effect of some physical and chemical properties of the soil after application bio-fertilizers in Duhok Governorate- Iraq.

Mohammed. A. Hussain* **Bakhtiyar.H.Mohammed ****

Dr.Mohammedali1953.@Gmail.com Bakhtiyar.Mohammed@uod.ac

***Dept. of Field Crops, College of Agricultural Engineering Sciences, University of Duhok , Duhok, Kurdistan Region, Iraq.**

****Dept. of Soil and Water Science, College of Agricultural Engineering Sciences, University of Duhok, Duhok, Kurdistan Region, Iraq.**

- **Date of research received 16/6/2021 and accepted 26/8/2021**

Abstract

The experiment was applied during spring 2020 at the farm of College of Agricultural Engineering Science Dohuk university to mingute the effect of various bio fertilizer levels on production nodules and some chemical and physical soil attributes after bio fertilizer soil application. The treatment consist of five rate of bio fertilizer (0,12,16,20 and 24 Kg ha^{-1}) (Corabac® G), using randomize complete block design(RCBD) with three replications using local variety of chickpea, The results exhibited that the bio fertilizer levels were highly significant effect on number of nodules, plant seed yield, first pod height and number of pods $plant^{-1}$.The level 24 Kg ha^{-1} gave highest values for nodules plant (73) by increasing 48% compare with control, the maximum yield value 610 Kg ha^{-1} was recorded by the same levels and also the results showed the highest values for plant height (55 cm), number of main branches $plant^{-1}$ (4.0), secondary branches 8.33 and number of pods $plant^{-1}$ 25. The application of bio fertilizer decreased pH from (7.94 to 7.5), EC from (0.55 to 0.522 $ds.m^{-1}$) while increase K from (0.17 to 0.21 $mmol_c.l^{-1}$) and organic matter from (17.1 to 19.4 $gm.kg^{-1}$). this results indicated that the bio fertilizer application to soil remarked positively from plant development and attributes to change in some physical and chemical properties of soil.

Key words: Bio fertilizers, chickpea.

انتاج الحمص والتاثيرعلى بعض الخصائص الفيزياوية والكيمياوية للتربة بعد اضافة السماد الحيوي في محافظة دهوك-العراق.

محمد علي حسين[1]، بختيار حسن محمد[2]
Bakhtiyar.Mohammed@uod.ac Dr.Mohammedali1953.@Gmail.com

1-قسم المحاصيل الحقلية/كلية علوم الهندسة الزراعية /جامعة دهوك /دهوك / اقليم كوردستان العراق
2-قسم علوم التربة والمياه/كلية علوم الهندسة الزراعية /جامعة دهوك /دهوك / اقليم كوردستان العراق

- **تاريخ استلام البحث 2021/6/16 تاريخ قبول نشر 2021/8/26 .**

الخلاصة

نفذت تجربة خلال الموسم الربيعي لعام 2020 في حقل كلية علوم الهندسة الزراعية –جامعة دهوك لدراسة تأثير مستويات مختلفة من السماد الحيوي(كورباك جي) على تكوين العقد البكتيرية وبعض الخصائص الفيزياوئية والكيمياوئية للتربة. كانت المعاملات مكونة من خمس مستويات (0,12,16,20,24 كغم/هكتار) من السماد الحيوي و صنف محلي من الحمص وبتصميم القطاعات العشوائية الكاملة (RCBD) وبثلاث مكررات.

أظهرت النتائج ان المستويات المختلفة من السماد الحيوي لها تاثيرا معنويا على عدد العقد البكتيرية وحاصل البذور وارتفاع اول قرنة وعدد القرنات في النبات وان المستوى 24 كغم/هكتاراعطى اعلى قيمة لعدد القرنات نبات (73) وبزيادة مقدارها 48% باالمقارنة مع معاملة المقارنة واعلى حاصل للبذور 610 كغم/هكتار وارتفاع نبات 55سم وعدد الفروع الرئيسية (4)والثانوية 8.33 وعدد القرنات في النبات 25. كما ادت اضافة السماد الحيوي الى نقصان في ال pH من(7.94 الى 7.5) و Ecمن(0.55 الى 0.522 $dS.m^{-1}$) وزيادة في البوتاسبوم من(0.17 الى 0.21 $mmol_c.l^{-1}$)،والكاليسيوم من (2.53 الى 2.65 $mmol_c.l^{-1}$)كما حصلت زيادة في النيتروجين والفسفور الجاهز بلغت(73 الى 91 $mg.kg^{-1}$)و(3.85 الى 5.08 $mg.kg^{-1}$) على التوالي و كذلك المادة العضوية من 17.1(الى 19.4غم /كغم).

من النتائج اعلاه يتبين ان اضافة السماد الحيوي قد اثر تاثيرا معنويا في بعض صفات النمو للمحصول وكذلك مساهمة في احداث بعض التغيرات في الخصائص الفيزياوئية والكيمياوئية للتربة

كلمات مفتاحية: سماد حيوي ، الحمص .

Introduction

Chick pea (*Cicer arietinum* L.) is one of the suitable plants growth broadly in most of the arid region and dry farming in developing countries. Chickpea is good source of protein to feed the people, also the chickpea has inactive root system and releases organic matters regularly to the soil. Bio fertilizers has many beneficial effect on chickpea production, bio fertilizer rather these are carrier based preparations containing growth in rhizosphere, play vital role in nutrient mineralization, increase nutrient accumulation ultimately increase crop yield without deterioration of nature. The bio fertilizer plays important role to reduce chemical fertilizer and improve soil fertility.

Bio fertilizer play active role in biological control pathogens, the method, form and type of the applied fertilizer are considered the most limiting factors for yield and quality of chickpea. Bio fertilizer stimulate plant grow synthesis of hormones and increase phosphorus intake and nitrogen bio fixation many researchers studied the effect of bio fertilizer application on agricultural soil (Rabieyan, *et al*., 2011; Mustafizar, 2018; singh *et al*., 2018).

Bio fertilizer may colonize the rhizosphere and promotes growth by increasing the variability and supply of nutrients and\or growth stimulus to crop.

Nitrogen fixation and phosphate solubilizing microorganisms play an important role in supplementing nitrogen and phosphorus to the plant. Also application fertilizer to alkaline soils has been reported reduce pH of soil (Taalab, *et al*.2008). some important strains are mentioned as plant growth promoting rhizobacteria (PGPR) and that can be used as Bio fertilizers (Kennedy, *et al*., 2004).

The aim of this study was to determine chickpea yield and soil chemical and physical attributes under different application rate of Bio fertilizer to soil.

Materials and Methods:

Experimental Site:

Afield experiment was carried out at the farm of the college of Agricultural-Engineering-Science,Dohuk-University at sub-tropical climate zone(36.8608° N,42.8476° E).

Rainfall during spring season of year 2019-2020 and the properties of chemical and physical of site was represented in Table (1).

Experimental Treatment:

The experimental units consist of four rows with 3-meter length and the distance between rows 0.30 m and using randomize complete block design with three replications. Local variety of chickpea used in this study, with five levels of bio fertilizer (0, 12, 16, 20 and 24) Kg. ha^{-1} (Corabac® G).

The bio fertilizer was applied with sowing date. The all experiment crop management was done according to the recommended cultural. The soil sample was taken before sowing and after harvesting, analysis of data the data were recorded from randomly on five plants to study the traits, number of nodules $plants^{-1}$, plant height, number of main and secondary branches $plants^{-1}$, number of pods $plants^{-1}$, and seed yield Kg. ha^{-1}.

The data were subjected to analysis of variance using mantab analysis and using Duncan's multiple range test (MRT) to compare the mean of treatments and determine the superiority of treatment.

Years	Months	rainfall mm	Average temperature C°	
			Max.	Min.
2019	Oct.	3	30.8	18.2
2019	Nov.	30	22.1	9.3
2019	Dec.	107	14.6	6.9
2020	Jan.	89.5	10.6	4.1
2020	Feb.	76	11.7	4.3
2020	Mar.	310	18.6	9.8
2020	Apr.	55	19.8	10.7
2020	May	16.5	21.2	11.6

Table:1 Average rainfall and air temperature data for the experiment field site during the planting season.

S.O.V	d.f	No. of nodule Plant^{-1}	yield Plants (g)	Plant height cm	No. of main branch Plant^{-1}	No. of secondary branch Plant^{-1}	First Pod height (cm)	No. of pod Plant^{-1}
Replication	2	709.27	3030	2.60	0.4667	1.8667	35.467	1.667
treatments	5	859.23**	30454**	8.77*	0.6000	5.5000*	67.067**	64.167**
Error	10	43.43	359	10.02	0.3000	0.7000	2.217	1.167
Total	17							

Results and Discussion:

The analysis of variance for the studied character under different levels of bio fertilizer shown in Table 2. The results exhibits that the bio fertilizer levels were highly significant effect on number of nodules, plant seed yield, first pod height and number of pods plant^{-1} while significant effect on plant height and number of secondary branches plant^{-1}, since non-significant of number of main branches plant $^{-1}$. Similar results were revealed by several researchers like Giri and Joshi, (2010), Kaur *et al*., (2006) and Sexena, (1993), which found that the effect of rhizobium and biotic to formation of nodules.

Table 2. Analysis of variance for studied traits chickpea under different levels of bio fertilizer.

Table 3 clarified the mean of studied characters under varying levels of bio fertilizer. From this table we can notice the highest value of number of nodules plant^{-1} was found in 24 Kg ha^{-1} bio fertilizer which record (73) by increasing 48% compare with control followed by (20) Kg ha^{-1} exhibited 65.33 by increasing 42%, that indicated the number of nodules plant^{-1} was affected by the highest treatment of bio fertilizer and play important role to encourage the plant of formation the highest number of nodules. For seed Kg ha^{-1} , the results in relation to yield of chickpea as effected by different bio fertilizer levels, the maximum yield value 610 Kg ha^{-1} was recorded by 24 Kg ha^{-1} application while the lowest value 344.20 Kg ha^{-1} was shown in control with increasing 44% in total seed yield of chickpea this indicated that bio fertilizer stimulate plant growth and contribute to improvement of ecosystem and the bio fertilizer play an active role in biologic control of plant pathogenies and also release gibberellin, biotin and auxin, these compound are reactive in promotion of plant growth, the

simulate plant growth synthesis of hormones increase phosphorus intake and nitrogen fixation (Sexena,1993; Tik *et al*., 2005 and Kizikaya, 2008). Concerning the plant height , number of main branches plant $^{-1}$ were recorded values not differ with control, while the number of pods plant^{-1} observed significant effect and result in seed yield of chickpea, the maximum value was (25) in application 24 Kg ha^{-1} whereas the minimum value (14) was demonstrated by control. similar results were reported by (Rabieyan et al., 2011;Mustafizar, 2018; and singh et al., 2018).

Treatments Kg.ha^{-1}	No. of Nodules plant^{-1}	Seed yield kg.ha^{-1}	Plant height cm	No. of main branches Plant^{-1}	No. of secondary branches Plant^{-1}	First Pod height cm	No. of pods. plant^{-1}
Control	35.00b	344.20d	52.00a	3.00a	5.33b	34.67a	14.00c
12	38.33b	419.60c	51.33a	3.33a	5.33b	28.00b	16.00c
16	44.67b	445.70bc	52.67a	3.33a	6.67ab	25.33bc	20.33b
20	65.33a	480.70b	55.00a	4.00a	7.67ab	23.33c	23.00ab
24	73.00a	610.0a	55.00a	4.000a	8.33a	23.33c	25.00a
p. value	0.000	0.000	0.519	0.187	0.007	0.000	0.000

Means that do not share a letter are significantly different at p value <0.05.

(Table 3) Mean of some growth studied traits chickpea under different bio fertilizer levels.

The results in Table 4 confirmed the agronomic efficiency percent under varying of bio fertilizer after soil application, the results remarked that the maximum percent value was noticed at 24 Kg ha^{-1} and the value was 11.496%, whilst the minimum percent value 6.969 was recorded at 216 Kg ha^{-1} , so that the bio fertilizer at the adequate quantity promote growth and microbial population of the soil and as a result increase soil productivity and also bio fertilizer application to the soil may easily nitrogen fixation. (Nirmala *et al.,* 2019 and Giri Joshi, 2010). The agronomic efficiency was calculated by using the following formula

$$AE = \frac{\text{YFT}-\text{YCT}}{\text{ARFT}}$$

Where,

AE= Agronomic efficiency in Kg of seeds per Kg nutrient applied

YFT= Yield in treatment fertilized Kg. ha^{-1}

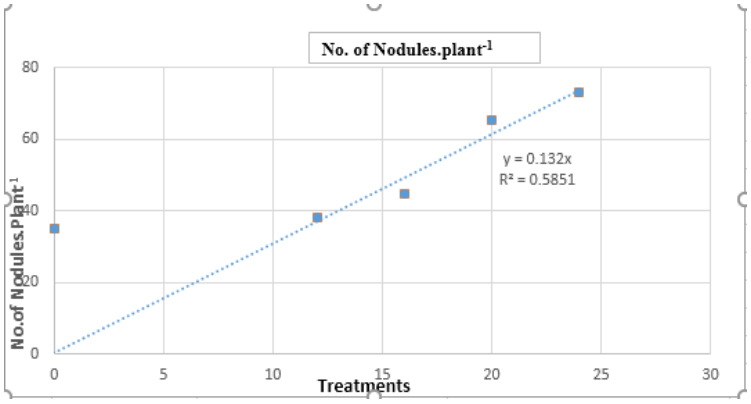
treatment	YFT	YCT	ARFT	AE
12	419.6	334.2	12	7.117
16	445.7	334.2	16	6.969
20	480.7	334.2	20	7.325
24	610.1	334.2	24	11.496

YCT= Yield in control treatment Kg. ha^{-1}

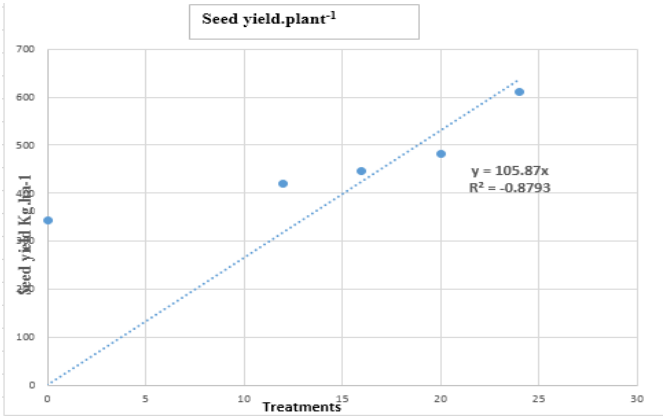
ARFR= Application rate in treatment fertilizer Kg. ha^{-1}

Table 4. Agronomic efficiency under different levels of bio fertilizer.

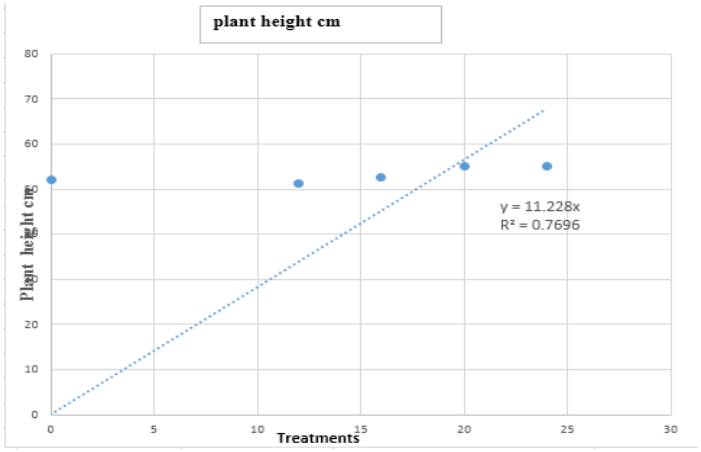
The application of bio fertilizer at different levels to soil which planting by chickpea increase the most studied characters fig. (A - G). The highest value for coefficient determination for number of nodules $plant^{-1}$, seed yield, plant height, number of main and secondary branches $plant^{-1}$, first pod height and number of pods $plant^{-1}$and recorded the value (0.5851), (0.8793), (0.7696), (0.8339), (0.8694), (0.6112) and (0.8954) respectively. The value indicated that seed yield of chickpea depend on number of pods $plant^{-1}$ and these secondary and main branches $plant^{-1}$.



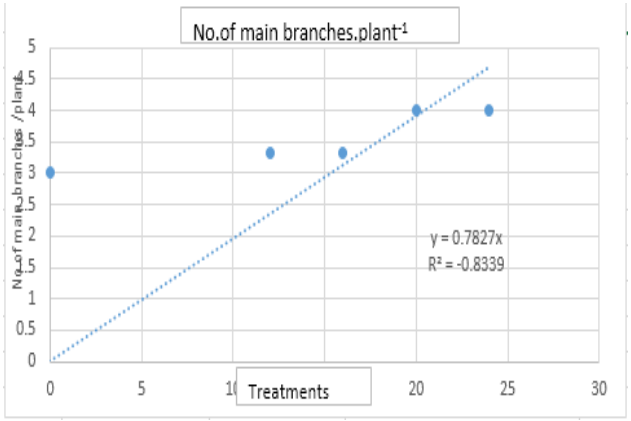
(A)



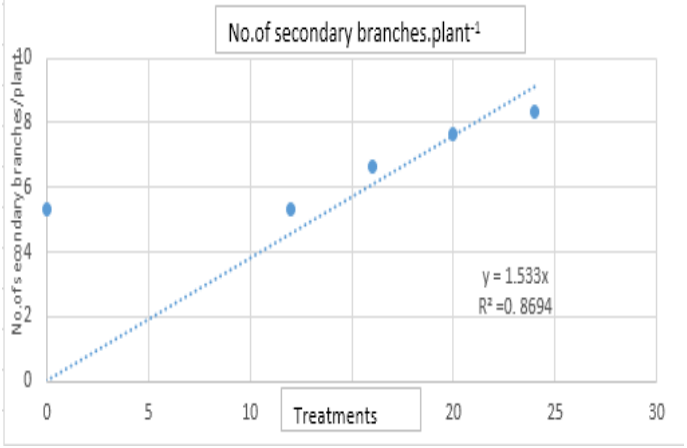
(B)


plant height cm
Plant height cm
Treatments
y = 11.228x
R² = 0.7696

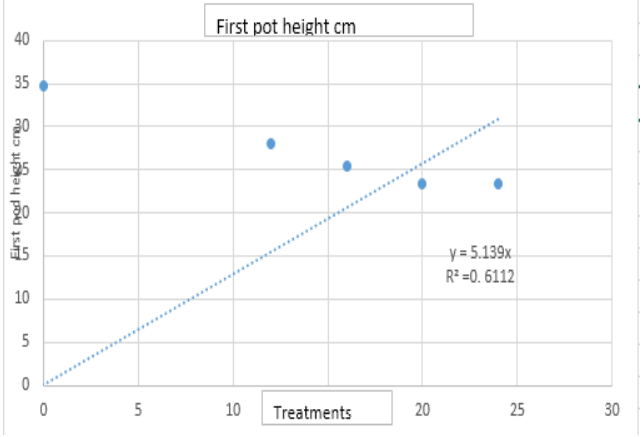
(C)


No.of main branches.plant-1
No.of main branches /plant
Treatments
y = 0.7827x
R² = -0.8339

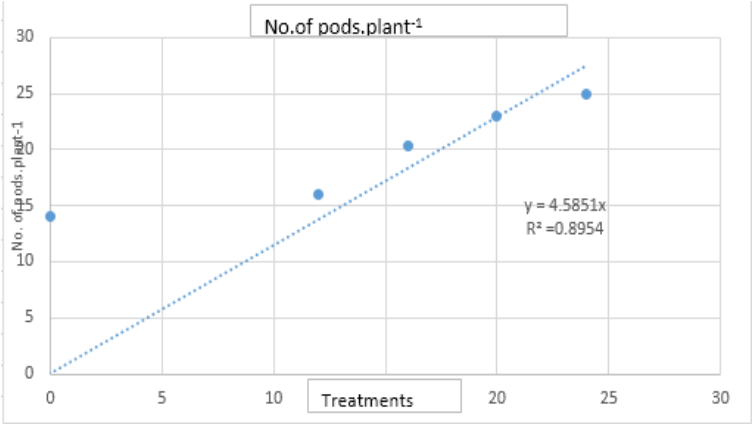
(D)


No.of secondary branches.plant-1
No.of secondary branches/plant
Treatments
y = 1.533x
R² =0. 8694

(E)


First pot height cm
First pod height cm
Treatments
y = 5.139x
R² =0. 6112

(F)


No.of pods.plant-1
No. of pods.plant-1
Treatments
y = 4.5851x
R² =0.8954

(G)

	No. of Nodules	Seed yield kg.ha-1	Plant height Cm	No. of main branches	No. of secondary branches	Pod height
Seed yield kg. ha^{-1}	0.807**					
Plant height cm	0.531*	0.410				
No. of main branches	0.584*	0.485	0.282			
No. of secondary branches	0.538*	0.680**	0.651**	0.497		
Pod height cm	-0.355	-0.654*	-0.409	-253	-0.712**	
No. of pods	0.784**	0.854**	0.428	0.704**	0.744**	-0.717**
*Correlation significant at p< 0.05 ** Correlation significant at p< 0.01						

The data in Table 5 recognized that the highly significant and positive correlation between seed yield of chickpea and some studied characteristic. The result shows significant value between seed yield o.854, 0.680 and 0.807 with number of pods plant^{-1} and number of nodules plant-1 respectively and the data

exhibited negative correlation between the studied traits. These results confirm the results in figure B,D,E,G.Similar trend was also by (Amare, *et al*., 2020).

Table:5 Simple correlation coefficient between yield and some growth parameters in chickpea.

Bio fertilizer to soil application in this study increase and reduce some physical and chemical properties of soil which planting by chickpea Table 6.

The result in same table confirmed that decreased pH from (7.94 to 7.5) and EC from (0.558 to 0.522 dSm^{-1}), while increase K from (0.17 to 0.21 mmol$_{C.}$ l^{-1}) and Ca from (2.53 to 2.65 mmol$_{C.}$l^{-1})$_{and}$ also increase the available nitrogen from (73 to 91 mg.kg^{-1}) (Hossain, *et al* 2005) and available phosphorus (P) from (3.85 to 5.08 mg.kg^{-1}) and organic matter from (17.1 to 19.4 g.kg^{-1}).

From this results indicated that the bio fertilizer application to soil, this relation was remarked positively from plant development and attributes to change in some physical and chemical properties of soil.

Similar result was also reported by (Dotaniya, *et al*. 2014).

Table (6) The chemical and physical properties of soil before and after the experiment.

Parameters	Units	(Depth 0-30) Before planting		(Depth 0-30) After planting
pH	1:2	7.94		7.5
EC	$dS.m^{-1}$	0.558		0.522
Ca^{2+}	$mmol_{C}.l^{-1}$	2.53		2.65
Mg^{2+}	$mmol_{C}.l^{-1}$	2.32		2.40
Na^{+}	$mmol_{C}.l^{-1}$	0.31		0.54
K^{+}	$mmol_{C}.l^{-1}$	0.17		0.21
HCO_3^-	$mmol_{C}.l^{-1}$	3.81		3.65
$CO_3^=$	$mmol_{C}.l^{-1}$	Appear		Appear
Cl^-	$mmol_{C}.l^{-1}$	0.71		0.72
$SO_4^=$	$mmol_{C}.l^{-1}$	0.71		0.66
Available nitrogen	$mg.kg^{-1}$	73		91
Available phosphorus P	$mg.kg^{-1}$	3.85		5.08
Organic matter	$g.kg^{-1}$	17.1		19.4
Cation exchange capacity	$Cmol.kg^{-1}$	29..2		32.1
Total calcium carbonate	$g.kg^{-1}$	211		215
Sand	$g.kg^{-1}$	84	Soil texture **silty clay**	78
Silt	$g.kg^{-1}$	432		430
Clay	$g.kg^{-1}$	484		492
Bulk density	$g.cm^{-3}$	1.28		1.25

References

1. **Amare. T, Asnake. F and Bantayhu. M. (2020**). Genetic variability and association analysis of Desi-type chickpea advanced lines under potential environmental in north Gondar Ethiopia. Congent food and Agriculture 6(1): 1-36.
2. **Dotaniya. Ml,pingoliya. K. K, M. Lata, R, Vema, K. L. Decwan, P. Dolanyia. (2014).** Role of phosphorus in chick pea production. African. J. of Agril. Resh. 9(51):3736- 3743.
3. **Giri, N and N-C Joshi.(2010).** Growth and yield response chickpea to seed inoculation with rhizobium sp. Natural and science , 8(9):232-236.
4. **Hossain.M.M. and Soman.(2005).** effect of biofertilizer and nitrogenous fertilizer on growth, yield and N uptake of lentil. Inter. Sustainable Agric. Technology 1(6):76-81.
5. **Kaur.R.,J.Macloed, W.Foley and M.Nayudu(.2006).**Gluconic acid :and antifungal agent produced by pseudomonas species in biological control of take-all. Photochemistry.67:595-604.
6. **Kennedy.IR., choudury. ATMA, and M.L.Kecskes.(2004).** Non symbiotic bacterial diazotrophs in crop-farming systems can their potential for plant growth promotion be better exploited? Soil biology and biochemistry.36(8):1229-1244.
7. **Kizilkaya.R.(2008).** Yield response and nitrogen concentration of spring wheat inoculated with Azotobacter chrococum strains. Ecological Engineering. 33:150-156.
8. **Mustafizar.G.K.M.(2018).** Performance of bio fertilizers on growth and yield of chickpea. Course code-ss 598. .
9. **Nirmala. K,Suchhanda.M, Mahapa tra, P,Meetei.T.T and Y.B.Devi.(2019**). Effect of bio fertilizer and micronutrients on yield chickpea. Hnt.Curr. microbial. App.sci.8(1): 2389-23297.
10. **Rabieyan.z, Yarina. M and H. Kazemi.(2011).** Effect of bio fertilizer on yield and yield components of chickpea under different irrigation levels. Australian. J. of basic and Applied sciences. 5(2):3139-3145.
11. **Sexena.M.C.(1993).** The challenge of developing biotic and abiotic stress resistance in cool-season food legumes. Pp3-14 John wiley and Sons.Chichesster,UK .
12. **Singh.R, Protab.T,Singh.D, Singh G.H and Singh.A.K.(2018)**. Effect of phosphourus,Sulphur and bio fertilizers on growth attributes and yield of Chickpea. J. of pharmacoghosy and phytochemistry 7(2):3871-3875.

13. **Taalab.A.S,Hella.F.A and M.A.Abouseeda.(2008).** Influence of phosphorus fertilizers enriched either Sulphur on phosphorus availability and corn yield in calcareous soil arid region.Ozean.J. of App. Sciences. 1: 105-115.

14. **Tik.K.K.V.B.R,N. Ranganaki, K.K.De,R.Pal,A-K.sexana,C.shekher nautiyal,S.Mittal,and A.K.Tripath i.(2005).** Diversity of plant growth and soil health supporting bacteria. Current sciences,98:136-150.