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Effect of *Azotobacter* on physio-chemical characteristics of soil in onion field

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Abstract
Field experiment was conducted at Department of Biological Sciences, Allahabad, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad (U.P.) India during *rabi* season 2015-16 using *Azotobacter* in onion field. The results of field experiments revealed that at 100 DAT, soil pH of each treated plots vary from each other and treatment T_5 and T_6 has got lowest pH (7.2) as compare to all other treatments. Results of electrical conductivity showed that there was non significant difference in all the treatments ranging from $0.703 dsm^{-1}$ to $0.708 dsm^{-1}$. Similarly the maximum percent of organic carbon recorded in treatment T_6 (0.57%) followed by T_5 (0.52%) and lowest in treatment T_1 (0.46%). The maximum amount of phosphorus content found in treatment T_6 (25.4kg/ha) which was on par with T_5 (24.2kg/ha). The highest potassium content has recorded in treatment T_6 (347 kg/ha) and followed by T_5 (345 kg/ha) and lowest in T_1 (338kg/ha) as compare to all other treatments. Nitrogen and sulphur analysis of soil samples of different treatments showed that the treatment T_6 has highest nitrogen and sulphur contents with 222.8kg/ha and 18.5 kg/ha followed by T_5 with 221.2kg/ha and 18.1 kg/ha, respectively. Treatment T_1 has recorded lowest nitrogen (206.5kg/ha) and sulphur (12.7 kg/ha) content. Rests of the treatments vary with each other little amount.

Keywords: *Azotobacter*, agriculture, physio-chemical properties of soil, nitrogen, sulphur, onion

Introduction
Soil contamination or soil pollution is caused by the presence of xenobiotic (human-made) chemicals or other alteration in the natural soil environment. Industrial activity, agricultural chemicals or improper disposal of waste are on the hit-chart responsible for land degradation (Panagos *et al.* 2016) [17]. Finally all comes to soil health which is currently a very issue of interest as land resource is limited, so do agriculture area which keeps on decreasing day by day. The sole problem is just not about reduction in land area but major issue of concern is loss of fertility even up to 60% in past few decades (Bruinsma, 2003) [5].
Talking about present situation there is a long list of chemicals used as pesticide, herbicides and inorganic fertilizers to improve the yield but simultaneously an awareness is increasing about damages due unlimited use of such resources with the passage of time human realizes that nature itself contains cure and remedies although they may not effective much initially but with promising future of regenerating soil and its fertility.
Agriculture soil is presently facing so many problems like heavy metals, alteration in salt concentration, soil aeration and reduction in beneficial micro-organisms been observed within specific agro-ecological environments, experimental data from the field stating (Eni *et al.* 2010) [16]. These are all every important aspect to add up to other soil properties *viz* soil pH value, organic matter and clay contents, and influenced by the fertilization (Fytianos *et al.* 2001) [7] necessary for soil fertility.
What we may learn that nature contains everything in itself, we need to explore the natural remedies for long term benefits. One of the promising aspects is revitalizing through organic manure and microorganisms commonly known as PGPR. Among all the decontamination methods bioremediation appears to be the least damaging and most environmentally acceptable technique (Adriano *et al.* 1999) [2].
Presence of *Azotobacter* spp. in soils has beneficial effects on soil and plants also the abundance of these bacteria is related to soil physical-chemical (e.g. organic matter, pH, temperature, soil moisture) and microbiological properties by affecting availability of N, P, K and S (Rai *et al.* 2014) [20].

Nitrogen supply to the plant will influence the amount of protein, amino acids, protoplasm and chlorophyll formed. Therefore, adequate supply of nitrogen is necessary to achieve high yield potential in crop (Mahmoud *et al*. 2000; Devi *et al*. 2003; Lee *et al*. 2003; abdel-Mawgoud *et al.* 2005) [14, 6, 13, 1]. Nitrogen (N) deficiency is frequently a major limiting factor for crops production. (Kizilkaya 2009) [12].

An adequate supply of nitrogen is associated with vigorous vegetative growth and more efficient use of available inputs which finally leads to higher productivity.

In order to be converted to available form it needs to be fixed through either the industrial process or through Biological Nitrogen Fixation (BNF). An interesting alternative to avoid or reduce the use of N-fertilizers could be the exploitation of Plant Growth-Promoting Bacteria (PGPB) capable of enhancing growth and yield of many plant species, several of agronomic and ecological significance. (Jnawali *et al* 2015) [11]. and *Azotobacter* is among one of them with very promising future *Azotobacter* spp. are non- symbiotic heterotrophic bacteria capable of fixing an average 20 kg N/ha/per year. (Rajaee *et al.* 2007) [19].

They are cost effective and inexpensive source of plant nutrients. Also they do not require nonrenewable source of energy during their production and improve crop growth arid quality of the product by producing plant hormones which helps in sustainable crop production through maintenance of soil productivity.

Bacterization help to improve plant growth and to increase soil nitrogen through nitrogen fixation by utilizing carbon for its metabolism. Thus present study is conducted to evaluate the effect of *Azotobacter* on physico-chemical characteristics of soil and soil quality when applied in *Azotobacter* form to onion crop.

The aim of the study was to examine the effect of PGPR *Azotobacter chroococcum* on germination, growth and yield of onion, as well as on the microbiological activity in the rhizosphere during the vegetation period of onion.

Materials and methods

The study was conducted at Department of Biological Sciences, SHUATS, Allahabad (U.P.), to evaluate the response of bio-fertilizer (Azotobacter) on soil quality in case of onion plantation. For achieving the purpose nitrogen in supplied to the soil with Azotobacter while phosphorus and potash was provided by inorganic fertilizer as per recommended dose. There were seven treatment *viz* T_0 (control NPK 100% RDF), T_1:0.33g/m^2, T_2:0.66g/m^2, T_3:0.99g/m^2, T_4:1.32g/m^2,T_5:1.66g/m^2, T_6:1.99g/m^2) the experiment layout is (RBD) with seven treatments and three replications. According to the treatment the *Azotobacter* are applied before transplanting and 30: 60 days after transplanting. given in powdered form of Azotobacter based on the idea as being bio organism they will self-replicate in soil so may fixed different amount of nitrogen available to crop and soil.

Table Soil characteristics of the experimental site

Particulars	**Sand**	**Silt**	**Clay**	**Textural class**	**Soil pH**	**EC(dsm^{-1} at 25^0 C)**	**Organic carbon**	**Available nitrogen (k ha^{-1})**	**Available phosphorus (k ha^{-1})**	**Available potassium (k ha^{-1})**
Value (0-30cm depth)	48.15%	20.30%	30.50%	Sandy Loam	7.2	0.708 dsm^{-1}	0.57%	198.2	18	332

Results and discussion

The optimum pH (Gonzalez-Lopez 1991). for the growth of *Azotobacter* spp. is near to 7.0. The abundance of these bacteria in soil is related to many factors, mostly soil pH and fertility (Jnawali *et al.* 2015) [11]. Study result shows that the treatment T_6 (7.2) has got lowest pH as compare to all other treatments. It's been observed in a soil sample study that the highest population was observed in soil samples with the range of pH=7–7.4 and it starts decreasing above 8 or in acidic pH (Mazinani *et al*. 2012) [15]. There is a linear relationship (Rousk *et al*. 2010). between soil bacterial communities and pH value as indicated bacterial population increases in the range of pH=4–8. The release of organic acids during the process of decomposition may be attributed to decline in soil pH. Ec was insignificant for different treatment was within the range of (0.703dsm^{-1}) to (0.708 dsm^{-1}) however the effect of different treatments on EC of soil was found in the range values varied from 0.20 to 0.32 dSm–1.(Rai *et al.* 2014) [20]. The treatment T_6 (0.57%) has recorded highest organic carbon. followed by T_5 (0.52%). Azotobacter presence increases in organic carbon content of the soil. These bacteria utilize atmospheric nitrogen gas for their cell protein synthesis. This cell protein is then mineralized in soil after the death of *Azotobacter* cells thereby contributing towards (Mazinani *et al.* 2012) [15]. The soil organic matter contents were suggested as the factors influencing the microbial population (Bashan 1990) [4]. As the *Azotobacter* population is low in dry and temperate zones. The treatment T_6 (222.8kg/ha) has recorded highest nitrogen content and nitrogen content which in non significant to T_5 (221.2kg/ha). *Azotobacter* spp. are non-symbiotic heterotrophic bacteria capable of fixing an nitrogen. Bacterization helps to improve plant growth and to increase soil nitrogen through nitrogen fixation by utilizing carbon for its metabolism similarly result was showed the highest nitrogen content and the lowest pH value. In the estimation of total Nitrogen of the soil samples it was observed range 1.25 to 60.05% (Mazinani *et al.* 2012) [15]. Significant increase was observed in nitrogen up to 30 kg/ha in case of safflower seed inoculation with Azotobacter and Azospirillum (Naseri and Mirzaei 2010) [16]. Azotobacter has important function in soil as they can fix 15-20 kg nitrogen /ha (Singh and Singh, 2007) [19]. *Azotobacter* could save about 20 kg/h nitrogen in wheat crop (Agrawal *et al*. 2004) [3]. Azotobacter chroococcum saved 25 per cent nitrogen in cabbage (Devi *et al.* 2003) [6]. For sulphur treatment T_6 (18.5kg/ha) has recorded highest sulfur contents followed by T_5 (18.1 kg/ha). Although cow dung have been proven more valuable source of sulphur (0.167mg/g) for onion (Gambo *et al.* 2009) [8]. But there shows significant increase in available sulfur content (16.76kg/ha) in onion field when Azotobacter was applied in combination of organic manure (Rai *et al.* 2014) [20].

The treatment T_6 (25.4kg/ha) has recorded highest phosphorus content and which in non significant to T_5 (24.2kg/ha). The increase in available phosphorus content of soil due to the incorporation of organic manures may be attributed to the direct addition of phosphorus as well as solubilization of native phosphorus through release of various organic acids during the decomposition of organic matter, similar results were obtained.

The treatment T_6 (347 kg) has recorded highest potassium content and followed by T_5 (345 kg/ha)The buildup of available P and K in the soil could be due to the organic acids which were released during microbial decomposition of VC increasing the available P and K in soil (Khan *et al.*1994). There was no significant influence on P and K levels in soil by this biofertilizers. The applied P and K chemical fertilizer also enhanced the P and K availability in soil.

Table 1: Showing effect of different dose of *Azettobecter* on soil characteristic compared from pre and post analysis of soil.

	Amount g/m^2	Soil pH	EC(dsm^{-1})	Organic Carbon %	Nitrogen Content Kg/ha	Phosphorus (Kg/ha)	Potassium (kg/ha)	Sulphur Content Kg/ha
Pre soil analysis		**7.5**	**0.703**	**0.38**	**198.2**	**18**	**332**	**9.8**
T1	Control	7.4	0.708	0.52	217.9	18.5	339	14.2
T2	32	7.4	0.703	0.46	206.5	19	338	12.7
T3	66	7.3	0.704	0.48	212.3	20	339	14.3
T4	99	7.3	0.703	0.50	217.0	21.6	340	15.2
T5	132	7.3	0.708	0.52	219.5	22.8	342	15.2
T6	166	7.2	0.708	0.52	221.2	24.2	345	18.1
T7	199	7.2	0.708	0.57	222.8	25.4	347	18.5

Table 2: Effect of Azotobacter on pH of soil sample of onion field

Treatment	Initial	50 DAT	75DAT	100DAT
T0	7.5	7.5	7.3	7.4
T1	7.5	7.5	7.3	7.4
T2	7.5	7.5	7.2	7.3
T3	7.5	7.5	7.2	7.3
T4	7.5	7.3	7.2	7.3
T5	7.5	7.4	7	7.2
T6	7.5	7.3	7	7.2
F-test		S	S	S
SE.d		0.05	0.09	0.05
CD (5%)		0.11	0.21	0.11

Table 3: Effect of Azotobacter on Electric conductivity dsm^{-1} of soil sample on onion field.

Treatment	Initial	50DAT	75DAT	100DAT
T0	0.705	0.706	0.707	0.708
T1	0.705	0.706	0.706	0.703
T2	0.705	0.705	0.706	0.704
T3	0.705	0.706	0.707	0.703
T4	0.705	0.705	0.706	0.708
T5	0.705	0.707	0.707	0.708
T6	0.705	0.706	0.707	0.708
F-test		S	S	S
SE.d		0.00	0.00	0.00
CD(5%)		0.00	0.00	0.00

Table 4: Effect of Azotobacter on organic carbon contents of onion field.

Treatment	Initial	50 DAT	75DAT	100DAT
T0	0.38	0.40±0.01	0.49±0.0057	0.52±0.0057
T1	0.38	0.42±0.005	0.42±0.0057	0.46±0.0057
T2	0.38	0.42±0.0	0.43±0.0057	0.48±0.0057
T3	0.38	0.42±0.005	0.43±0.0057	0.50±0.01
T4	0.38	0.42±0.01	0.44±0.01	0.52±0.01
T5	0.38	0.43±0.005	0.45±0.02	0.52±0.0057
T6	0.38	0.43±0.01	0.46±0.01	0.57±0.0057
F-test		S	S	S
SE.d±		0.01	0.01	0.01
CD (5%)		0.01	0.02	0.01

Table 5: Effect of Azotobacter on nitrogen contents (Kg/ha) of onion field.

Treatment	initial	60 day	80 day	100day
T0	198.8	207.2 ±1.03	210.8 ±1.42	217.9 ±1.68
T1	198.8	202.3 ±2.18	204.0 ±3.00	206.5 ±1.00
T2	198.8	204.2 ±4.05	205.7 ±3.06	212.3 ±2.02
T3	198.8	204.5 ±1.00	210.4 ±2.00	217.0 ±1.97
T4	198.8	207.2 ±0.01	212.5 ±1.00	219.5 ±1.32
T5	198.8	210.5 ±0.75	215.1 ±1.00	221.2 ±2.00
T6	198.8	210.5 ±2.03	216.9 ±2.00	222.8 ±.53
F-test		S	S	S
SE.d		1.76	1.59	1.13
CD (5%)		3.83	3.45	2.46

Table 6: Effect of Azotobacter on Phosphorus (Kg/ha) contents of onion field

Treatment	Initial	50 DAT	75DAT	100day
T0	13.5	14.3±14.4	16±0.40	18.5±0.07
T1	13.3	14.5±0.35	17±0.57	19±0.71
T2	13.5	15.4±0.14	17.5±0.21	20±0.71
T3	13.5	16.5±0.30	18.2±0.49	21.6±0.85
T4	13.5	17.8±0.14	19.5±1.41	22.8±1.98
T5	13.5	19.2±0.07	20±1.77	24.2±0.14
T6	13.5	20.6±0.14	21.5±2.83	25.4±0.14
F-test		S	S	S
SE.d		0.23	0.81	0.70
CD(5%)		0.49	1.76	1.53

Table 7: Effect of Azotobacter on Potassium contents (kg/ha) of onion field.

Treatment	Initial	50 DAT	75DAT	100day
T0	332	334±1.00	315±0.42	339±0.42
T1	332	333±0.35	313±0.71	338±1.06
T2	332	335±0.50	314.2±0.20	339±0.85
T3	332	335.8±0.34	316.2±0.14	340±1.41
T4	332	337±0.31	318.5±0.14	342±0.35
T5	332	338±0.29	319±0.35	345±0.49
T6	332	340±0.27	321.5±0.35	347±0.14
F-test		S	S	S
SE.d		0.78	0.43	0.96
CD(5%)		1.71	0.94	2.09

Table 8: Effect of different doses of Azotobacter on sulphur contents of onion field.

Treatment	Initial	50 DAT	75DAT	100day
T0	9.8	10.2 ±0.06	11.4 ±0.08	14.2 ±0.03
T1	9.8	10.3 ±0.21	10.4 ±0.56	12.7 ±0.88
T2	9.9	10.5 ±0.48	11.2 ±0.02	14.3 ±0.02
T3	9.8	10.4 ±0.03	11.3 ±0.02	15.2 ±0.05
T4	9.8	10.7 ±0.03	11.4 ±0.03	15.2 ±0.11
T5	9.8	11.6 ±0.02	12.1 ±0.08	18.1 ±0.65
T6	9.8	11.8 ±.03	13.3 ±0.02	18.5 ±0.22
F-test		S	S	S
SE.d		0.17	0.05	0.35
CD(5%)		0.27	0.10	0.77

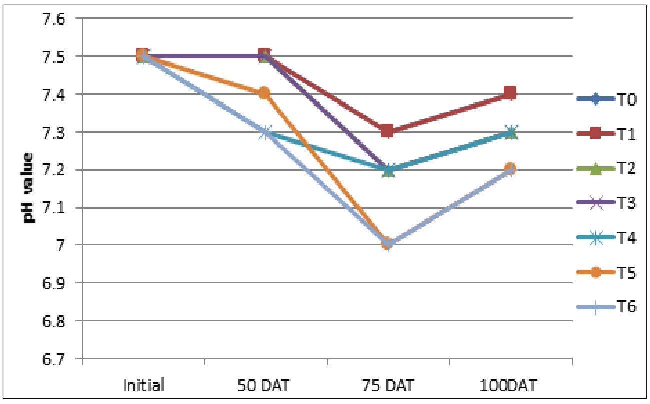

Fig 1: Effect of different doses of Azotobacter on pH of soil sample of onion field

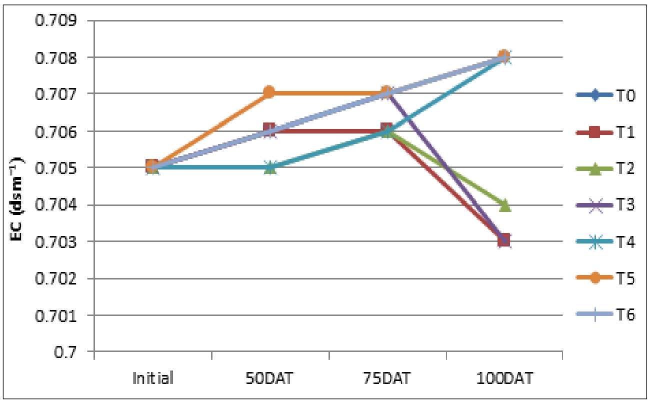

Fig 2: Effect of Azotobacter on electrical conductivity (dsm^{-1}) of soil sample on onion field

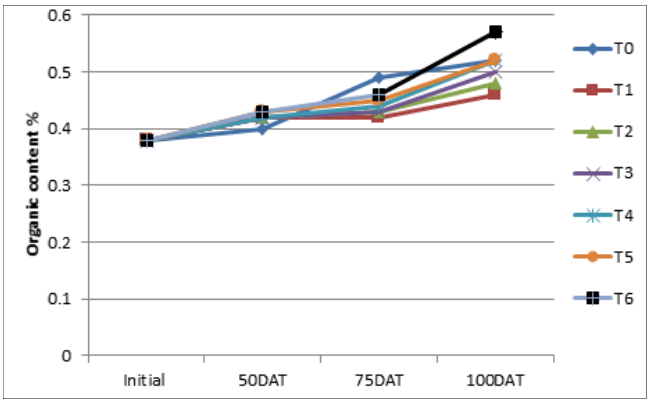

Fig 3: Effect of different doses of Azotobacter on organic carbon content (%) of onion field.

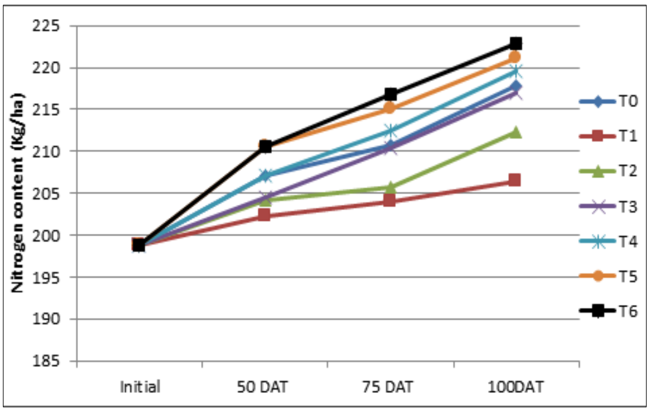

Fig 4: Effect of different doses of Azotobacter on nitrogen content (kg/ha) on onion field.

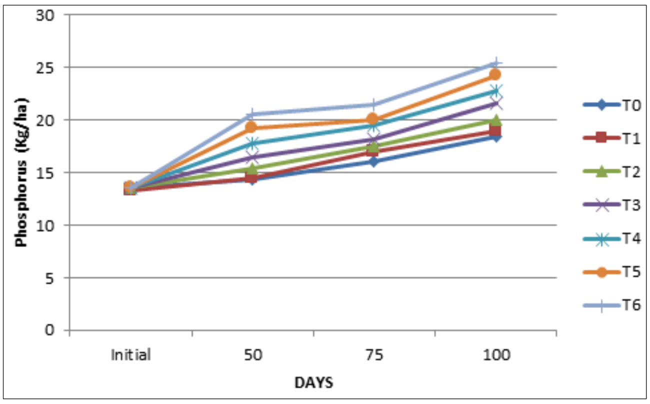

Fig 5: Effect of different doses of Azotobacter on phosphorus content (kg/ha) of onion field.

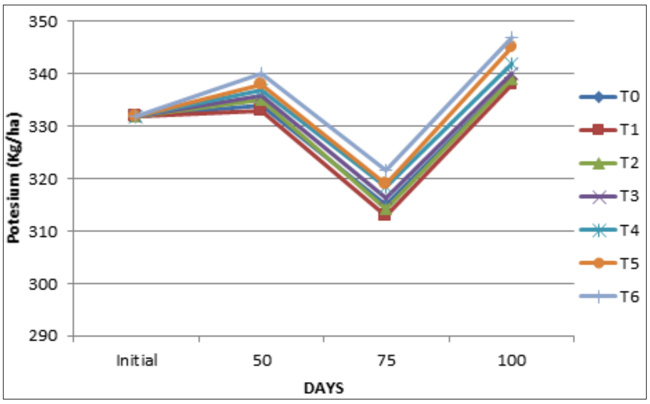

Fig 6: Effect of different doses of Azotobacter on potassium content (kg/ha) of onion field.

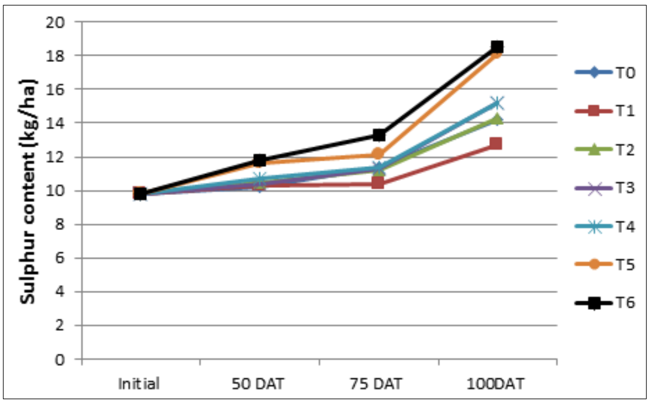

Fig 7: Effect of different doses of Azotobacter on sulphur contents of onion field.

Conclusion

Present study may conclude that Azotobacter influences positively on However among different treatments T_5 and T_6 show optimum results. Application of Azotobacter also It helps to increase nutrient availability and to restore soil fertility for better crop response. It is an important component of integrated nutrient management system due to its significant role in soil sustainability. This research is necessary in future to explore the potentiality of *Azotobacter* in soil fertility and improved soil quality

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References

1. Abdel-Mawgoud AR, Abou-Hussein SR, El-Nemr MA. Interactive effects of zinc and different nitrogen sources on yield and quality of onion. Arab-Universities J of Agric. Sci. 2005; 13:863-875.
2. Adriano DC. Trace elements in terrestrial environments: Biogeochemistry, bioavailability and risks of metals (2nd ed.). New York: Springer-Verlag, 2001.
3. Agrawal N, Singh HP, Savita US. Effect of Azotobacter inoculation and graded doses of nitrogen on the content, uptake and yield of wheat in a mollisol. Indian J Agric. Res. 2004; 38:288-292
4. Bashan Y. Can. J Microbiol. 1990; 36:419-425.
5. Bruinsma J. Ed. World agriculture towards 20152030 an FAO perspective FAO Earthscan Rome London, 2003.
6. Devi AK, Limi-Ado, Singh NG. Effects of inorganic and biofertilizers on bulb yield and economics of multiplier onion (*Allium cepa* L. var. Aggregatum Don). News-Letter National. Horticultural Research and Development Foundation. 2003; 23:1-3.
7. Fytianos K, Katsianis G, Triantafyllou P, Zachariadis G. Accumulation of heavy metals in vegetables grown in an industrial area in relation to soil, Bull. Environ. Contam. Toxicol. 2001; 67:423-430.
8. Gambo BA, Dikko AU, Magaji MD. Elemental Sulphur Content of Onion Bulb (*Allium cepa* L.) as affected by Cow-Dung, Nitrogen, and Weed interference in the Sokoto Rima Fadama Nigerian Journal of Basic and Applied Science. 2009; 17:194-197. ISSN0794-5698
9. Gonzalez-lopes JM, Martinez-Toledo V, Reina S, Salmeron J. Technol And Environ Chem. 1991; 33:69-78.
10. Eni I. Effects of Land Degradation on Soil Fertility: A Case Study of Calabar South, Nigeria. Environmental Land Use Planning, Dr. Seth Appiah-Opoku (Ed.), InTech, DOI, 2012, 10. 5772/51483
11. Jnawali1 AD, Ojha RB, Marahatta S. Role of *Azotobacter* in Soil Fertility and Sustainability A Review. Adv Plants Agric Res. 2015; 2:1-5
12. Kizilkaya R. Nitrogen fixation capacity of *Azotobacter* spp. Strains isolated from soils in different ecosystems and relationship between them and the microbiological properties of soils. J Environ Biol. 2009; 30:73-82.
13. Lee-Jongatae, Ha-Injong, Iee-Changung, Moon-Jinseong, Cho-Yongcho. Effect of N, P2O5 and K2O application rates and top dressing time on growth and yield of onion (*Allium cepa* L.) under spring culture in low land. Korean J of Horticultural Sci. and Technology. 2003; 21:260-266.
14. Mahmoud AF, Hosna FA, Sedera Shadia, Yousef BD. Effect of organic and inorganic fertilizers on onion crop. J Agric. Sci. Mansoura Univ. 2000; 25:5813-5829.
15. Mazinani1 Z, Aminafshar M, Ahmad, Chamani M. Effect of *Azotobacter* population on physico–chemical characteristics of somesoil samples in Iran. Annals of Biological Research. 2012; 3:3120-3125. ISSN 0976-1233.
16. Naseri R, Mirzaei A. Response of yield and yield components of safflower (*Carthamus tinctorius* L.) to seed inoculation with Azotobacter and Azospirillum and different nitrogen levels under dry land conditions. American-eurasian j agric & Eniviron sci. 2010; 9:445-449. ISSN1818-6769.
17. Panagos P, Van Liedekerke M, Yigini Y, Montanarella L. Contaminated Sites in Europe: Review of the Current Situation Based on Data Collected through a European Network. Journal of Environmental and Public Health, 2013, 10, 1155/2013/158764.
18. Rousk J, Baath E, Brookes PC, Lauber CL, Lozupone C, Caporaso JG, *et al*. Soil bacterial and fungal communities across a pH gradient in an arable soil. 2010; 4:1340-51
19. Singh D, Singh A. Role of biofertilizers in vegetable production. Intensive Agriculture. Krishi Vigyan Kendra Kumher (Bhartapur) Rajasthan, 2007, 24-26.
20. Rai S, Rani P, Kumar M, Rai AK, Shahi SK. Effect of Integrated use of Vermicompost, FYM, PSB and *Azotobacter* on Physico-Chemical Properties of Soil under Onion Crop Environment & Ecology. 2014; 32:1797-1803.