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Study Effects of Biological, Manure and Chemicals Nitrogen Fertilizer Application under Irrigation Management in Lentil Farming on Physiochemical Properties of Soil

Abdolkarim Keshavarz[1*], Naser Mohammadian Roshan[2], Maral Moraditochaee[2], Ebrahim Azarpour[2], Ahmad Shirin Fekr[3]

[1]Department of Environment, Lahijan Branch, Islamic Azad University, Lahijan ,Iran
[2]Department of Agriculture, Lahijan Branch, Islamic Azad University, Lahijan, Iran.
[3]Faculty of Tea Research Institute of Iran, lahijan, Iran

ABSTRACT

In order to study effects of biological, manure and chemicals nitrogen fertilizer application under irrigation management in lentil farming on physiochemical properties of soil an experiment in factorial format based on randomized complete block design with three replications during 2011 was conducted. Factors of experiment were consisting of irrigation management with two levels (I_1: dry farming and I_2: irrigate), the biological nitrogen fertilizer nitroxin with two levels (B_1: no inoculate and B_2: inoculate) and chemical, manure nitrogen fertilizer with six levels (N_1: control, N_2: 25 kg/ha nitrogen, N_3: cow manure, N_4: sheep manure, N_5: 25 kg/ha nitrogen + cow manure and N_6: 25 kg/ha nitrogen fertilizer + sheep manure). Studied traits were amounts of saturated mud acidity (pH), electrical conductivity (EC), ammoniac nitrogen (NH_4), nitrate nitrogen (NO_3), total nitrogen (N), potassium (K), phosphorus (P), organic matter (OM), copper (Cu), zinc (Zn), iron (Fe) and manganese (Mn). With attention to results of this study, irrigation and also inoculation by nitroxin had significant and positive effect in more traits. Also, between chemical, manure nitrogen fertilizer levels, almost the treatment of 25 kg/ha nitrogen + sheep manure in more traits was superior.

KEY WORDS: Irrigation; Nitroxin; Nitrogen; Lentil; Soil physiochemical properties

INTRODUCTION

Soil quality mainly depends on the response of soil to different land use systems and management practices, which may often modify the soil properties and hence soil productivity (Gurumurthy *et al*., 2009). Sustainable agriculture involves successful management of resources for increased agricultural production to satisfy changing human needs, while maintaining or enhancing the environment and natural resources (FAO, 1989). Soil organic matter plays key role in maintainability of soil fertility and productivity. The effect of the organic mater may be either direct or indirect. Organic matter acts directly as a source of plant nutrients and indirectly influences the physical and chemical properties. Farming practices, which involve heavy application of chemical fertilizers, may cause depletion of certain nutrients in soil and certain others would generally accumulate in excess resulting in nutrient imbalance, which affects soil productivity (Son *et al*., 2004). One of the best ways to maximize organic matter in soils is application of organic manures. Organic manure, apart from supplying Nitrogen (N) and other nutrients, it increases available moisture content of soils, moderates soil acidification resulting from repeated application of NPK fertilizers, improved soil bulk density, higher levels of carbon dioxide in plant canopy, increase buffering capacity against drastic change in PH, complexation of $A1^{3+}$ thereby reducing its toxicity, improves soil aeration and beneficial microbial activities, increase caution exchange capacity of the soil (Tisdale *et al.* 1985). Excessive application of chemical nitrogen fertilizer can result in a high soil nitrate concentration after crop harvest (Jokela and Randall, 1989; Roth and Fox, 1992; Gordon *et al*., 1993). This situation can lead to an increase in the level of nitrate contamination of potable water, because nitrate remaining in the soil profile may leach to groundwater (Singh *et al*., 1995). A great way to solve these problems is usage of biological nitrogen fixation. The utilization of biological nitrogen fixation method can decrease the use of chemical nitrogen fertilizer (urea), prevent the depletion of soil organic matter and reduce environmental pollution to a considerable extent (Choudhury and Kennedy, 2004). Several bacteria that are associated with the roots of crop plants can induce beneficial effects on their hosts and often are collectively referred to as PGPR (Plant Growth Promoting Rhizobacteria) (Vermeiren *et al*., 1999). The biological fixation of nitrogen produced by these organisms can constitute a significant and ecologically

***Corresponding Author:** Abdolkarim Keshavarz, Department of Environment, Lahijan Branch, Islamic Azad University, Lahijan ,Iran. EMail: AKK_Keshavarz@yahoo.com

favorable contribution to soil fertility (Vlassak *et al.*, 1992). Nitroxin is a biologic nitrogen fertilizer containing *Azospirillum* and *Azotobacter*. *Azospirillum* belongs to family *Spirilaceae*, heterotrophic and associative in nature. In addition to their nitrogen fixing ability of about 20 to 40 kg/ha, they also produce growth regulating substances (Arun, 2007). Although there are many species under this genus like, *Azospirillum amazonense*, *Azospirillum halopraeferens*, *Azospirillum brasilense*, but, worldwide distribution and benefits of inoculation have been proved mainly with the *Azospirillum lipoferum* and *A. brasilense*. *Azotobacter* belongs to family *Azotobacteriaceae*, aerobic, free living and heterotrophic in nature. Azotobacters are present in neutral or alkaline soils and *A. chroococcum* is the most commonly occurring species in arable soils. *Azotobacter vinelandii*, *Azotobacter beijerinckii*, *Azotobacter insignis* and *Azotobacter macrocytogenes* are other reported species. The number of *Azotobacter* rarely exceeds of 10^4 to 10^5 g^{-1} of soil due to lack of organic matter and presence of antagonistic microorganisms in soil (Subba, 2001). The bacterium produces anti-fungal antibiotics which inhibits the growth of several pathogenic fungi in the root region thereby preventing seedling mortality to a certain extent (Sheraz *et al*., 2010). Among available means to achieve sustainability in agricultural production, organic manure and bio-fertilizer play an important and key role because they possesses many desirable soil properties and exerts beneficial effect on soil physical, chemical and biological characteristics (Son *et al*., 2004). The current study aim was to investigate the influence of biological, manure and chemicals nitrogen fertilizer application under irrigation management in lentil farming on physiochemical properties of soil.

MATERIALS AND METHODS

For study effects of biological, manure and chemicals nitrogen fertilizer application under irrigation management in lentil farming on physiochemical properties of soil an experiment in split split plot format based on randomized complete block design with three replications during 2011 was conducted. The study was carried out in Deylaman region (north of Iran) located longitudes 49°48'19" E and latitudes 49° 57'51"N in south of Caspian Sea. The location of study area was showed in figure 1. The factors of experiment were consisting of irrigation management with two levels (I_1: dry farming and I_2: irrigate) as main factor, the biological nitrogen fertilizer nitroxin with two levels (B_1: no inoculate and B_2: inoculate) as sub factor and chemical, manure nitrogen fertilizer with six levels (N_1: control, N_2: 25 kg/ha nitrogen, N_3: cow manure, N_4: sheep manure, N_5: 25 kg/ha nitrogen + cow manure and N_6: 25 kg/ha nitrogen fertilizer + sheep manure). Chemical pure nitrogen was prepared from source of urea fertilizer (46% pure nitrogen). Studied traits were amounts of saturated mud acidity (pH), electrical conductivity (EC), ammoniac nitrogen (NH_4), nitrate nitrogen (NO_3), total nitrogen (N), potassium (K), phosphorus (P), organic matter (OM), copper (Cu), zinc (Zn), iron (Fe) and manganese (Mn). The data was analyzed using MSTATC software. The Duncan's multiple range tests (DMRT) was used to compare the means at 5% of significant.

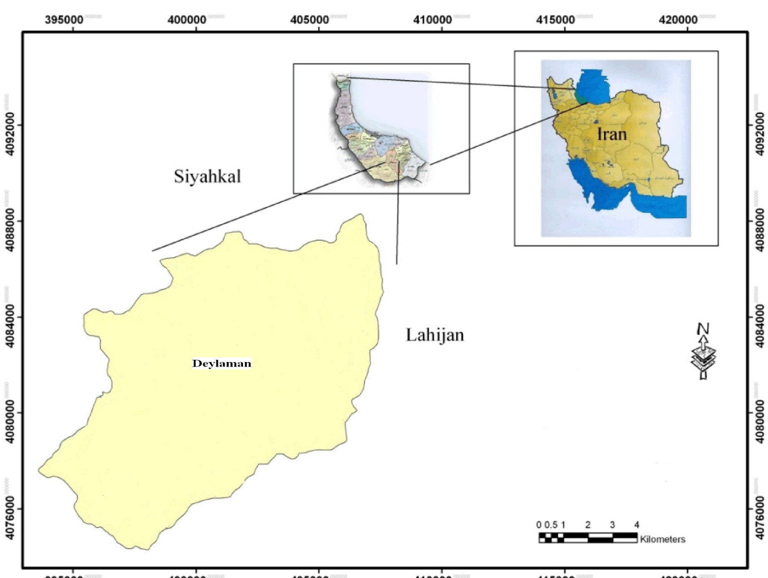

Figure 1. Location of the study area

RESULTS AND DISCUSSION

With attention to variance analysis table (Table 1), the effect of irrigation management on nitrate nitrogen, total nitrogen, potassium, phosphorus, organic matter and manganese showed significant differences at 1% probability level and on other measured traits was non significant. On the other hand, the effect of biological nitrogen fertilizer nitroxin application on nitrate nitrogen, total nitrogen, phosphorus, organic matter, zinc and manganese at 1% probability level and on copper at 5% probability level was significant. Also, effect of biological nitrogen fertilizer nitroxin on other studied traits was non significant. The effect of chemical and manure nitrogen fertilizer management on saturated mud acidity, electrical conductivity, nitrate nitrogen, total nitrogen, potassium, phosphorus, organic matter, copper, zinc, iron and manganese showed significant differences at 1% probability level but on other measured traits was non significant.

Table 1. Results of variance analysis for effects of irrigation, bio fertilizer nitroxin and chemical, manure nitrogen fertilizer on studied traits.

Source of variance	df	pH	EC	NH_4	NO_3	N	K
		Ms					
Replication	2	7.167	0.0272	293.91	178.49	0.006	17373
Irrigation (I)	1	0.00073	0.0186	307.76	2769.6^{**}	0.0003^{**}	92469^{**}
Biological fertilizer nitroxin (B)	1	0.00023	0.174	110.11	162.27^{**}	0.0006^{**}	389.43
Chemical, manure fertilizer (N)	5	0.003^{**}	0.0655^{**}	667.10	409.39^{**}	0.0004^{**}	23383^{**}
I×B	1	0.00073	0.00008	662.35	23.50	0.0005	84.43
B×N	5	0.00023	0.015	880.49	42.67	0.00006	1393.2
I×N	5	0.0002	0.0048	482.95	32.87	0.0001	2843.34
I×B ×N	5	0.00032	0.0065	857.17	47.70	0.00003	1677.37
Error	46	0.00042	0.0065	739.12	53.44	0.00004	2164.31
Source of variance	df	P	OM	Cu	Zn	Fe	Mn
		Ms					
Replication	2	14	0.043	0.056	0.002	0.051	1.001
Irrigation (I)	1	237.69^{**}	0.071^{**}	0.003	0.001	0.083	8.675^{**}
Nitroxin Bio-fertilizer (B)	1	195.95^{**}	0.099^{**}	0.01^{*}	0.033^{**}	0.023	1.397^{**}
Chemical, manure fertilizer (N)	5	69.97^{**}	0.044^{**}	0.0011^{**}	0.015^{**}	0.559^{**}	1.443^{**}
I×B	1	92.79	0.109	0.074	0.027	0.216	1.487
B×N	5	10.81	0.010	0.0018	0.0002	0.137	0.065
I×N	5	3.64	0.011	0.0012	0.0004	0.493	0.240
I×B ×N	5	2.22	0.0034	0.0006	0.0004	0.092	0.114
Error	46	9.20	0.0036	0.002	0.0017	0.121	0.17

ns,* and **: non significant, significant at the 5 and 1% level of probability respectively.

None of interaction levels between studied factors consist of irrigation × nitroxin, nitroxin × chemical and manure nitrogen, irrigation × chemical and manure nitrogen, irrigation × nitroxin × chemical and manure nitrogen were not showed significant differences in this study. Chavan *et al.* (2007) reported that the physicochemical properties of the soil improved significantly by the addition of organic manures and that there was very little change due to inorganic fertilizers. Comparison of means between studied traits showed in table 2. Among irrigation management levels, the highest amounts of nitrate nitrogen with 47.76, total nitrogen with 0.073%, potassium with 439.72 ppm, phosphorus with 13.29 ppm, organic matter with 0.66% and manganese with 3.42 ppm was recorded from irrigated treatment. On the other hand the lowest amount amounts of nitrate nitrogen with 35.35, total nitrogen with 0.069%, potassium with 368.04 ppm, phosphorus with 9.66 ppm, organic matter with 0.60% and manganese with 2.72 ppm were recorded from dry farming treatment. Similar results were reported by Henr and Hogg, (2003); Filintas *et al*., (2006). Among biological nitrogen fertilizer nitroxin application levels, the maximum values of nitrate nitrogen with 46.30, total nitrogen with 0.074%, phosphorus with 13.12 ppm, organic matter with 0.67%, copper with 0.74 ppm, zinc with 0.21 ppm and manganese with 3.21 ppm were found from inoculated level with biological nitrogen fertilizer nitroxin. Also, the minimum values of nitrate nitrogen with 36.81, total nitrogen with 0.068%, phosphorus with 9.82 ppm, organic matter with 0.59%, copper with 0.72 ppm, zinc with 0.16 ppm and manganese with 2.93 ppm were recorded from no inoculated level. Similar results were obtained by Roger and Ladha, 1992; Wani and Lee, 1995. Between chemical and manure nitrogen fertilizer management levels, the highest amounts of electrical conductivity with 0.62 ds/m, nitrate nitrogen with 50.31, total nitrogen with 0.08%, potassium with 473.73 ppm, organic matter with 0.72%, iron with 0.99 ppm and manganese with 3.57 ppm were obtained by application of 25 kg/ha nitrogen + sheep manure application treatment. The lowest amounts of electrical conductivity with 0.42 ds/m was recorded from cow manure treatment. The minimum values of nitrate nitrogen, total nitrogen, potassium, organic matter, iron and manganese respectively with 34.76, 0.064%, 356.03 ppm, 0.57%, 0.43 ppm and 2.62 ppm were obtained from control treatment (without use of chemical nitrogen, cow and sheep manure). The maximum amount of saturated mud acidity was obtained from control treatment with 8.19 and the minimum amount of this trait jointly was recorded from 25 kg/ha nitrogen + cow manure and also from 25 kg/ha nitrogen + sheep manure with 8.15. The highest values of phosphorus with 15.36 ppm, copper with 0.77 ppm and zinc with 0.24 ppm were recorded from application of 25 kg/ha nitrogen + cow manure treatment. Combined application of organic manure and chemical fertilizer improves soil fertility, soil physical and chemical properties (Nyangani, 2010). The lowest values of phosphorus with 8.93 ppm was recorded from control management. Minimum of copper was obtained from 25 kg/ha nitrogen application with 0.69 ppm. Also, the lowest value of zinc with 0.15 jointly was recorded from control and also 25 kg/ha nitrogen fertilizer application treatments. Similar results were found by Joshi et al., (1994); Son and Ramaswami, (1997).

Table 2. Effects of irrigation, nitroxin biofertilizer and chemical, manure nitrogen fertilizer on studied traits.

Treatment	PH	EC	NH_4	NO_3	N	K	P	OM	Cu	Zn	Fe	Mn
Irrigation (I)												
I_1	8.16a	0.47a	44.66a	35.35b	0.069b	368.04b	9.66b	0.60b	0.72a	0.18a	0.73a	2.72b
I_2	8.17a	0.50a	40.52a	47.76a	0.073a	439.72a	13.29a	0.66a	0.74a	0.19a	0.67a	3.42a
Nitroxin Bio-fertilizer (B)												
B_1	8.17a	0.47a	46.5a	36.81b	0.068b	401.55a	9.82b	0.59b	0.72b	0.16b	0.72a	2.93b
B_2	8.16a	0.50a	38.68a	46.30a	0.074a	406.21a	13.12a	0.67a	0.74a	0.21a	0.68a	3.21a
Chemical and manure nitrogen fertilizer (N)												
N_1	8.19a	0.43c	31.73a	34.76d	0.064d	356.03a	8.93c	0.57c	0.71cd	0.15d	0.43b	2.62c
N_2	8.17ab	0.43c	54.02a	37.25cd	0.067d	368.28cd	9.42c	0.57c	0.69d	0.15d	0.47b	2.8c
N_3	8.16bc	0.42c	38.01a	38.69cd	0.07c	368.4cd	12.54b	0.60c	0.76ab	0.20b	0.81a	2.92bc
N_4	8.17ab	0.49cb	44a	42.22bc	0.071cb	435.51ab	10.26cb	0.66b	0.72bcd	0.17bcd	0.69ab	3.25ab
N_5	8.15c	0.52b	42.71a	46.09ab	0.076ab	403.33bc	15.36a	0.66b	0.77a	0.24a	0.82a	3.24ab
N_6	8.15c	0.62a	45.08a	50.31a	0.08a	473.73a	12.33b	0.72a	0.74abc	0.19bc	0.99a	3.57a

Within each column, treatments that carry the same superscript letter are not significantly different at $P<0.05$.

REFERENCES

Arun, K.S., 2007. Bio-fertilizers for sustainable agriculture. Mechanism of Psolubilization. Sixth edition, Agribios publishers, Jodhpur, India. pp.196-197.

Chavan, D.A., M.S. Deshmukh, S.S. More and W.N. Narkhede, 2007. Impact of longterm fertiliser application on yield and nutrient availability in sorghum- wheat cropping system. Paper presented at the state level seminar on soil health enhancement for food and environmental security, Parbhani 12-13 October 2007.

Choudhury, A.T.M.A and I.R. Kennedy, 2004. Prospects and potentials for systems of biological nitrogen fixation in sustainable rice production. Bio. Fer. S., 39: 219-227.

FAO., 1989. Sustainable development and natural resource management. Food and Agriculture Organization of the United Nations, Rome, FAO Agriculture series No. 22, Chapter 3, pp. 84-90.

Filintas, T.A.G., I.P. Dioudis, T.D. Pateras, N.J. Hatzopoulos, and G.L. Toulios, 2006. Drip Irrigation Effects in Movement, Concentration and allocation of Nitrates and Mapping of Nitrates with GIS in an Experimental Agricultural Field. Proceedings of International Conference on: Information Systems in Sustainable Agriculture, Agroenvironment and Food Technology (HAICTA*)*, September 20-23, Volos, Greece, 253-262.

Gordon, W.B., D.A. Whitney, R.J. Raney, 1993. Nitrogen management in furrow irrigated, ridge-tilled corn. J. Pord. Agric., 6: 213-217.

Gurumurthy K.T., M. Kirankumar and H.C. Prakasha, 2009. Changes in physico chemical properties of soils under different land use systems. Karnataka J. Agric. Sci., 22(5) .1107-1109.

Henr, J.L and T.J. Hogg, 2003. Evaluation of the Effects of Irrigation on Soil Chemical and Physical Properties. Irrigation sustainability – Saskatchewan activity, Canada askatchewan Irrigation Diversification Center, Canada.

Jokela, W.E and G.W. Randall, 1989. Corn yield and residual soil nitrate as affected by time and rate of nitrogen application. Agron. Progress Rep. p. 398.

Joshi, G.C., D.D. Haokip, and K.N. Singh, 1994. Effect of green manuring on the physical Properties of soil under a rice wheat cropping system. Journal of Apicultural science. Cambridge, 122: 7- 13.

Nyangani, E.T., 2010. Effect of combined application of organic manure and CHEMICAL fertilizers on soil properties and crop yields: a review. Nigerian Journal of Science, Technology and Environmental Education,Vol. 3, No. 1.28-32.

Roger, P.A., and J.K. Ladha, 1992. Biological N2 fixation in wetland rice fields: estimation and contribution to nitrogen balance. Plant Soil.141:41-5.

Roth, G.W and R.H. Fox, 1992. Corn hybrid interaction with soil nitrogen level and water regime. J. Pord. Agric.5: 137-142.

Sheraz Mahdi, S., G.L. Hassan, S.A. Samoon, H.A. Rather, A. Dar and B. Zehra, 2010. Bio-Fertilizers in organic agriculture. J. Phy., 2(10): 42-54.

Subba, R.N.S, 2001. An appraisal of biofertilizers in India. The biotechnology of biofertilizers, (ed.) S. Kannaiyan, Narosa Publication House, New Delhi.

Singh, B., Y. Singh and G.S. Sekhon, 1995. Fertilizer N use efficiency and nitrate pollution of groundwater in developing countries. J. Contam. Hydrol., 20: 167-184.

Son, T.T.N. and P.P. Ramaswami, 1997. Effect of organic wastes application on physical and chemical properties of heavy clay soil. Omon Rice 5: 48-55

Son, T.T.N., V.V. Thu, L.H. Man, H. Kobayashi and R. Yamada, 2004. Effect of long term application of organic and biofertilizer on soil fertility under rice-soybean-rice cropping system. Omonrice 12: 45-51.

Tisdale, S.L., W.L. Nelson, and J.D. Beaton, 1985. Soil and Fertilizer Potassium. Ch. 7 in S.L. Tisdale, W.L. Nelson, and J.D. Beaton (eds). Soil Fertility and Fertilizers, 4th ed. Macmillan, New York. 249-291.

Vermeiren, H., A. Willems, G. Schoofs, R. De Mot, V. Keijers, W. Hai and J. Vanderleyden, 1999. The rice inoculant strain Alcaligenes faecalis A 15 is nitrogen-fixing Pseudomonas stutzeri. Appl. Microbiol., 22: 215- 224.

Vlassak, K., L. Van Holm, L. Duchateau, L. Vanderleyden and R. De Mot, 1992. Isolation and characterization of fluorescent Pseudomonas associated with the roots of the rice and banana grown in Sri Lanka. Plant Soil, 145: 51- 63.

Wani, S.P., and K.K. Lee, 1995. Microorganisms as biological inputs for sustainable agriculture in Organic Agriculture (Thampan, P.K.ed.) Peekay Tree Crops Development Foundation, Cochin, India. Pp-39-76.