Advances in Applied Agricultural Sciences

Volume 2 (2014), Issue 1, 1-6

Journal homepage: www.aaasjournal.org

ISSN: 2383-4234

Research Article

Effects of manure and soil texture on soybean plants

Mohammad Reza Mahmoodabadi[1*] and Abdol-Majid Ronaghi[2]

[1] *MSc of soil science and expert of Agri bank, Birjand, Iran.*

[2] *Department of Soil Science, College of Agriculture, Shiraz University, Shiraz, Iran.*

ARTICLE INFO

Article history:

Received 14 December 2013
Revised 9 January 2014
Accepted 10 January 2014
Available online 25 January 2014

Keywords:
Cattle Feedlot Manure
Growth
Soil Texture
Soybean

* Corresponding Author;
E. mail: razereza2002@gmail.com

ABSTRACT

Organic materials have many positive effects on physical, chemical, and biological characteristics of soils. So they have an important function in improving the soil fertility. The main purpose of this greenhouse study was to evaluate the impact of cattle feedlot manure and soil texture on growth, nutrient concentration of soybean plants and some physico-chemical properties of soil. Treatments consisted of three levels of manure (0, 2 and 4% based on dry weight) with three different soil textures (sandy clay loam (SCL), clay loam (CL) and clay (C)). Results indicated that application of cattle feedlot manure led to increment of shoot dry weight. Maximum weight of soybean dry weigh obtained from SCL2 treatment. Application of manure was led to significant increment of solubility of nutrient elements for plant absorption. The results of this experiment demonstrated that soil texture and manure content of soils have an important compact on soybean growth and development.

© 2014 AAAS Journal. All rights reserved.

Introduction:

Generally plants absorb nutrients via their roots; therefore, it is proposed to apply fertilizers into the soil (Mengel 2002). Numerous experiments have indicated that soil application of organic manure will improve its physical properties, chemical characteristics and fertility status.

In arid and semi-arid regions of Iran, most soils seem to have low organic matter contents and soil application of organic wastes can at least supply a part of the plant nutrient requirement. Abdel-Ghaffar (1982) believed that in arid and semi-arid regions of the world, the two most important limiting factors of crop production are water and organic matter. In the same way, usages of organic materials are the most important means to create healthy food for humans (Walen et al. 2001). It was confirmed that organic materials such as compost create fertility in the soil, and increase the availability of phosphorus and micronutrients in a different way (McDonagh et al. 1995).

Soybean plants have the ability to fix nitrogen via symbiosis mechanism; however, all of their nitrogen needs are not met through fixation (Sawyer et al. 2006). Sawyer et al. (2006) found that it is appropriate to provide approximately 50 percent soybean plants' nitrogen of need via other ways such as manures. Under this condition, plants will fix their remaining nitrogen requirement.

It was shown that plant yield is related to the type of the texture and organic contents of soil (Quiroga et al. 2001; Wakeel et al. 2002).

The main aims of the present study were to assess the effects of cattle feedlot manure and soil texture on growth and micronutrients of soybean plants.

Materials and Methods

A pot experiment was conducted with Soybean plants cv. Williams on April 2012, planted in pots containing 3 kg of selected soil under greenhouse condition. Sufficient quantity of unfertilized Ramjerdi's soil from the surface layer (0-30 cm) containing less organic matter was collected in Cultivation Station of Agriculture of Shiraz University of Iran. The applied soil was classified into the great group of fine, mixed, mesic and Fluventic Haploxerepts (Soil Survey Staff 2006). After drying the soil and passing it through a 2-mm sieve, some physico-chemical characteristics were determined. Soil texture and organic matter contents were assessed using hydrometer method and Walkley and Black method, respectively. The electrical conductivity (EC_e) and pH of saturated paste were calculated using EC meter and pH meter, respectively. Cation exchange capacity (CEC) was evaluated by sodium acetate method. The equal calcium carbonate was assessed via neutralizing method using HCl. Total nitrogen, available phosphorus and extractable potassium were assessed using Kjeldal, yellow ammonium-molybdate methods and flame photometer (Corning 405) , respectively. Micronutrients were extracted using DTPA (Diethylen Triamene Penta Acetate), and their concentration were determined with atomic absorption spectrophotometer (Shimadzo AA-670; Shimadzu Corporation, Japan) (Table 1). Cattle feedlot manure was used as organic source in this experiment. Cattle feedlot manure was air-dried and passed through a 2-mm sieve, and then some chemical properties from the soil were determined (Table 2). After selection of three soil textures and based on soil test, 50 mg N kg^{-1} as $CO(NH_2)_2$ (½ before planting and ½ one month after planting), 25 mg P kg^{-1} as KH_2PO_4, 5 mg Fe kg^{-1} as Fe-EDDHA, 5 mg Mn kg^{-1} as $MnSO_4$, 2.5 mg Cu kg^{-1} as $CuSO_4$ and 5 mg Zn kg^{-1} as $ZnSO_4.2H_2O$ were uniformly added to all pots.

Treatments included:

1. Prepared sandy loam soil without manure (SLW)

2. Prepared sandy loam soil with 2 percent manure per kg of soil (SL2)

3. Prepared sandy loam soil with 4 percent manure per kg of soil (SL4)

4. Prepared sandy clay loam soil without manure (SCLW)

5. Prepared sandy clay loam soil with 2 percent manure per kg of soil (SCL2)

6. Prepared sandy clay loam soil with 4 percent manure per kg of soil (SCL4)

7. Prepared clay soil without manure (CW)

8. Prepared clay soil with 2 percent manure per kg of soil (C2)

9. Prepared clay soil with 4 percent manure per kg of soil (C4)

Six seeds of soybean cv. Williams were sown in depth of 1.5-2 cm in each pot, and thinned to 3 seedlings per pot ten days after emergence. The pots were irrigated using distilled water to keep soil moisture near the field capacity (FC). Plants were harvested sixteen weeks after emergence; both shoot and roots isolated, then rinsed with distilled water, dried at 65°C and then weighed. Total nitrogen of plant shoots and roots was determined by micro-kjeldahl method. Shoots were ground and dry-ashed at 550°C and analyzed for iron (Fe), manganese (Mn), zinc (Zn) and cupper (Cu) by atomic absorption spectrophotometer (Shimadzo AA-670; Shimadzu Corporation, Japan). At the end of experiment, soil sub samples were taken from each pot and analyzed for total nitrogen, $NaHCO_3$-extractable phosphorus (Olsen P), DTPA-extractable Fe, Mn, Zn and Cu concentrations. Electrical Conductivity (EC_e) and potassium were determined in the saturation paste. The experiment was set up using completely randomized design with nine treatments, three replications and three plants per replication. Data were analyzed with MSTATC software and differences among means compared by Duncan's multiple range test (DMRT) at 5% level of confidence.

Results and Discussion

As data shown, application of manure at 4% level reduced the root dry weight, and this reducing response of roots was higher in clay textures than others (Table 3.). Regarding to table 4, the highest electrical conductivity (EC) was obtained from clay soils, and it is suggested that salinity can depress the root dry weight. Despite the moderate sensitivity of soybean to soil salinity, the apparently high tolerance of this cultivar to salt stress in the present study (Table 3) might suggest that the adverse effects of soil salinity were probably alleviated by the constant water logging.

The highest rate of total nitrogen in shoot part was measured with C4 treatment. The lowest rate of total nitrogen of shoot and root were obtained with SLW treatment (Table 3). The highest amount of total nitrogen of root came from C4 (Table 3). In addition, data showed an increment of total nitrogen in both shoot and root as manure content increased.

Table 1. *Some of physic-chemical characteristics of soils*

parameter	Soil Texture		
	Clay	Sandy Clay Loam	Sandy Loam
Clay (%)	48	32	16
Sand (%)	29	55	72
OM (%)	0.23	0.16	0.1
pH (water)	7.5	7.5	7.9
K(saturation paste) (mg L^{-1})	384	309	196
ECe (dSm^{-1})	0.27	0.3	0.5
Olsen P	7.4	6.1	5
Fe (mg kg^{-1})	3.9	2.7	2.1
Mn (mg kg^{-1})	3.6	3.9	4.5
Zn (mg kg^{-1})	0.56	1	1.3
Cu (mg kg^{-1})	1.9	1.7	1.4
CEC ($Cmol_c kg^{-1}$)	21	16	11

Table 2. *Analytical characteristics of cattle feedlot manure*

characteristic	quantity
pH (1:5 manure: water)	8.7
pH (1:5 manure:$CaCl_2$)	8.5
Ash (%)	44.9
Total N (%)	2.15
C:N ratio	20.9
Total P (mg kg^{-1})	8000
Total K (mg kg^{-1})	341
Total Fe (mg kg^{-1})	1093
Total Mn (mg kg^{-1})	772
Total Zn (mg kg^{-1})	432
Total Cu (mg kg^{-1})	27
EC_e (dS m^{-1}) (1:5 manure: water)	7.9

With regards to table 4, it is clear that the highest and lowest rates of total nitrogen in the pot mixtures were obtained from C4 and SLW treatments, respectively. This fact suggests that under these treatments, plants exposed to higher rates of nitrogen than others. Data indicated the highest and lowest rates of cupper concentration of shoots in C2 and SL2 treatments (Table 3). In the clay treatments, increments of manure content from 2 to 4% reduced Cu concentration of shoots. Reduction of Cu concentration might be attributed to salinity effects on Cu uptake (Hassan et al. 1970); formation of stable Cu-OM complexes (Sims and Patrick 1974); interaction between Cu and other micro nutrients and some disorders which occurred in Cu uptake (Singh et al. 1999).

Results indicated that application of manure increased iron concentration of shoots (Table 3). Regarding table 1, it is clear that there were high rates of phosphorus and iron concentration in clay soils, and it is well-known that there are antagonistic correlation between iron and phosphorus in soils (Marschner 1986). Thus, it can be concluded that in CW texture, phosphorus and iron reduced their absorption by plant. On the other hand, application of manure increased iron uptake by plant shoots. This effect of manure may be due to higher solubility of iron in the soil solution resulted from adjustment of pH or formation of stable Fe-OM complexes (Barker and Pilbeam 2007). Application of manure in all treatments increased the electrical conductivity of the soil solution (Table 4.). Moreover, increment of

manure levels from 2 to 4% increased this parameter compared with non-manured treatments (Table 4.).

The highest K concentration was obtained in sandy loam, which was approximately 1.1 times higher than the sandy clay loam and 1.2 times higher than the clay soils. This phenomena could be attributed to the fact that potassium fixed in soil, particularly those with higher percentage of clay minerals that composed of two layers of silica tetrahedral and one layer of alumina octahedral (i.e. 1:2) as mica illite or vermiculite, which make spaces just fit as same as potassium ions (Abdelrazzag 2002).

Table 3. *Effects of applied cattle feedlot manure and soil texture type on the dry weight, total nitrogen and micronutrient concentration of soybean plants.*

Treatments	Shoot D.W. (g)	Root D.W. (g)	Shoot total N (%)	Root total N (%)	Shoot Cu (mg kg^{-1})	Shoot Fe (mg kg^{-1})	Shoot Zn (mg kg^{-1})	Shoot Mn (mg kg^{-1})
SLW	2.66d	1.26ab	0.77d	0.35d	15.49d	46.37e	22.68a-c	113.56e
SL2	4.04bc	1.37a	1.18ab	0.60c	11.33e	50.49c-e	15.47c	97.88e
SL4	4.18bc	1.24ab	1.02c	0.90ab	16.96d	59.71b-e	21.64bc	114de
SCLW	5.36a	0.85cd	0.95c	0.63c	18.95cd	38.77e	24.08a-c	135.98cd
SCL2	5.62a	1.06bc	1.17ab	0.82bc	20.00c	80.40ab	22.92a-c	140.80cd
SCL4	5.44a	0.99c	1.14b	1.10a	17.07cd	66.80b-d	23.99a-c	132.28de
CW	3.64c	0.71d	1.00c	0.89ab	26.30b	37.97e	21.17bc	174.60ab
C2	4.80ab	0.85cd	1.17ab	1.10a	34.40a	83.16ab	28.67ab	191.18a
C4	5.22a	0.64d	1.26a	1.12a	23.56b	90.44a	33.56a	170.66a-c

Table 4. *Effects of applied cattle feedlot manure and soil texture type on some parameters of soil after harvest time*

Treatment	EC (dSm^{-1})	Total N (%)	P ($mg\ kg^{-1}$)	K ($mg\ l^{-1}$)
CW	0.38f	0.71d	4.00h	2.48e
C2	0.85d	0.91b	8.02e	16.89d
C4	2.78a	1.20a	10.18c	30.92b
SCLW	0.38f	0.48f	4.84gh	2.52e
SCL2	0.69e	0.63e	9.39d	19.49d
SCL4	1.55b	0.81c	12.95a	32.22ab
SLW	0.31f	0.23i	3.78h	2.95e
SL2	0.61e	0.33h	7.26f	22.43c
SL4	1.37c	0.46g	11.20b	34.76a

Within each column, same letter indicates no significant difference between treatments at 5% probability levels.

Table 5. *Effects of applied cattle feedlot manure and soil texture type on extractable cupper, iron, zinc and manganese concentration of soils after harvest time*

Treatment	Cu $mg\ kg^{-1}$	Fe $mg\ kg^{-1}$	Zn $mg\ kg^{-1}$	Mn $mg\ kg^{-1}$
CW	5.07a	9.17cd	3.38b	11.92c
C2	4.37ab	9.96ab	3.86ab	13.79ab
C4	5.56a	10.53a	4.34a	15.87a
SCLW	2.79cd	8.09ef	1.57de	8.45e
SCL2	4.29ab	9.44bc	2.18cd	10.19cd
SCL4	5.01a	9.36bc	2.68c	11.02c
SLW	2.02d	7.70f	1.14e	6.83e
SL2	3.52bc	8.68cde	1.80de	8.14e
SL4	4.24ab	8.53de	1.97cd	8.47de

Within each column, same letter indicates no significant difference between treatments at 5% probability levels.

Supply of manure to soil led to an increase in extractable Cu, Fe, Zn and Mn concentrations of soil (Table 5.). Results showed that extractable concentrations of iron, zinc and manganese were higher in mixtures containing clay. Saha et al. (1999) reported that Negative effect of $CaCO_3$ on extractable Cu in acidic soils could be deducted by addition of organic matter. Zhou and Wang (2001) showed that soluble organic matter increased Cu extractability, especially in calcareous soils. Increment of sand into soil mixtures led to a significant depression in soil Fe, Zn, Mn and Cu concentrations after harvest time (Table 5.).

Conclusions

These data indicated that use of cattle feedlot manure improved the growth rate and chemical composition of soybean plants and regarding to low organic contents of soils in Iran, it is recommended to supply this plant with essential amount of manures.

References

1. Abdel-Ghaffar A S (1982) The significance of organicmaterials of Egyptian agriculture andmaintenance of soil productivity. FAO/SIDAWorkshop: Organic Materials and Soil Productivity. FAO Soil Bulletin 45: 12–15.

2. Abdelrazzag A (2002) Effect of chicken manure, sheep manure and inorganic fertilizer on yield and nutrients uptake by onion. *Pakistan Journal of* Biological Science 5 (3): 266-268.

3. Barker A V, and Pilbeam D J (2007) Handbook of Plant Nutrition. CRC Press.

4. Hassan N A K, J V Drew, D Knudsen, and Olsen R A (1970) Influence of soil salinity on production of dry matter and uptake and distribution of nutrients in barley and corn. I. Barley (*Hordeum vulgare* L.). Agronomy Journal 62: 43-45.

5. Marschner H (1986) Mineral nutrition in higher plants. New York: Academic Press.

6. McDonagh J F, B Toomsan, V Limpinuntana, and Giller K E (1995) Grian legumes and green manures as pre-rice crops in Northes Thailand. II. Residue decomposition. Plant and Soil 177: 127-136.

7. Mengel k (2002) Alternative or complementary role of foliar supply in mineral nutrition. Acta Horticulturae 594: 33–47.

8. Quiroga A, M Dfaz Zorita, and Buschiazzo D (2001) Safflower productivity as related to soil water storage and management practices in semiarid region. Communications in Soil Science and Plant Analysis 32: 2851-2862.

9. Saha J K, T Adhikari, and Mandal B (1999) Effect of lime and organic matter on distribution of zinc, copper, iron and manganese in acid soils. Communications in Soil Science and Plant Analysis 30: 1819-1829.

10. Sawyer J, M Helmers, A Mallarino, K Lamkey, and Baker J (2006) Environmental Protection Commission – Alternative Considerations Regarding Liquid Swine Manure Application Rates to Soybean. September 14, 2006. Iowa State University, Ames, IA.

11. Sims J L, and Patrick W H (1974) The distribution of micronutrient cations in soil under conditions of varying redox potential and pH. Soil Science Society of America Journal 42: 258-262.

12. Singh N P, R S Sachan, P C Pandey, and Bisht P C (1999) Effect of decade long term fertilizer and manure application on soil fertility and productivity of rice-wheat system in a Mollisol. Journal of the Indian Society of Soil Science 47: 72-80.

13. Soil Survey Staff (2006) Keys to soil taxonomy. 10th Ed., U. S. Govern, Print. Office, Washington, DC.

14. Wakeel A, A Hassan, T Aziz, and Igbal M (2002) Effect of different potassium levels and soil texture on growth and nutrient uptake. Pakistan Journal of Agricultural Science 39(2): 99-103.

15. Walen J K, C Ching, and Olson B M (2001) Nitrogen and phosphorus mineralization potentials of soil receiving reported annual manure applications. Biology and Fertility of Soils 34: 334-341.

16. Zhou L X, and Wang J W C (2001) Effect of dissolved organic matter from sludge and sludge compost on soil copper sorption. Journal of Environmental Quality 30: 878-883.