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Investigation effects zeolite and their integrated bio-fertilizer and different levels of chemical nitrogen fertilizer under irrigation management on physiological traits Peanut (*Arachis hypogaea* L.)

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ABSTRACT

In order to determine the effect of zeolite mineral, bio-fertilizers and different levels of chemical nitrogen fertilizer under limited irrigation water management on peanut yield and its water use efficiency, a field experiment was conducted at Astaneh Ashrafiyeh province located at North of Iran. In 2010 growing season, Factorial split-plot in randomized complete block design with three replications was used. main plot was consisted of water regimes treatments (I_1=dry land and I_2=12 day Interval Irrigation) and sub factor was consisted of combination treatments of zeolite mineral (Z_1= 0 and Z_2=7 ton ha^{-1}), bio-fertilizers and different levels of chemical nitrogen fertilizer (N_1=0, N_2= Azospirillum + Azotobacter, N_3= 30 kg N ha^{-1}+ Aazospirillum + Azotobacter, N_4= 60 kg N ha^{-1}+ Aazospirillum + Azotobacter and N_5= 90 kg N ha^{-1}+ Aazospirillum + Azotobacter) was performed. The results of this investigation showed that all physiological traits (plant growth rate, pod growth rate, partitioning coefficient and during growth period from pod filling) were significantly affected by applying the suggested treatments. The Maximum partitioning coefficient were obtained under 12 days irrigation management (1.14); application of 7 ton ha-1 zeolite (1.143); application 30 kg N ha-1+ Aazospirillum + Azotobacter (1.23).

Key words: Peanut, Irrigation, Zeolite, Bio-fertilizer, physiological traits.

INTRODUCTION

Peanut after soybean is one of the most important oil seed plants in tropical and sub-tropical regions that is planted often for its seeds rich in oil and protein. The oil of peanut is one of the most important vegetable oil in regions where other oily vegetables cannot grow up [11]. Increasing of global demands from one side and various productions and by-products from the other side determine the economic importance of this crop [16].

Surface irrigation is one of the oldest irrigation methods in which water is distributed as an open flow throughout a field. In fact, influenced by the gravity, water flows and moisturizes the whole surface of the field or part of it [18]. Infiltration is considered as one of the important parameters for designing irrigation systems based on which irrigation management and planning is done [17]. At the beginning, the infiltration rate is high, but in the long run, it gradually decreases until it reaches an approximately constant rate. Hence, the infiltration rate is of great significance in terms of irrigation because it is a determining factor for storing a certain amount of water in the soil. Final soil infiltration is the permeability which the soil shows in long durations. Moreover, during early stages, soil moisture is more effective on the infiltration rate. When air becomes stuck between the wetting front and the confining layer, its pressure increases and in turn, reduces the infiltration rate [18].

These properties have spurred their use for agronomic and horticultural applications as well [5]. Zeolites are natural minerals first discovered in 1756 by Swedish mineralogist, who named the porous minerals from the Greek words meaning "boiling stone" [10]. They are hydrated alominosilicates, characterized by three dimensional networks of SiO4 and AlO4 tetrahederal, liked by the sharing of all oxygen atoms. The partial substitution of Si+4 by Al+4 lead to an excess of negative charge which is compensated by cations. In structure of natural zeolite the water and cations can be reversibly removed or replaced by other cations [14]. Clinoptilolites are one kind of zeolites which are not the most well known yet, but are one of the most useful zeolites. Extensive deposits clinoptilolite are found in Western United State, Bulgaria, Hungary, Japan, Australia and Iran [10]. The size of clinoptilolite channels controls the size of the molecules or ions that can pass through them and therefore a zeolite like clinoptilolite can act as a chemical sieve allowing some iones to pass through while blocking others [10]. Amendment of clinoptilolite zeolite to sandy soils has been reported to lower nitrogen concentration in the leachate and to increase moisture and nutrients in the soil due to increased soil surface area and cation exchange capacity [8]. Additionally, clinoptilolite zeolite is a more permanent addition to the root zone, demonstrating good stability in weathering, impact and absorption tests [12].

Nitrogen has a critical role in producing agricultural products and selecting the amount of nitrogen-containing fertilizers is necessary for having the highest production level. Absorption of adequate amounts of nitrogen by a plant leads to more protein content and larger cereal and legume seeds. Generally, the more the concentration of nitrogen in leaves, the more the intensity of carbon-making would be because aside from being found as protein in plants, nitrogen is the main element in the chlorophyll synthesis and its fixation could lead to more growth of aerial parts. Usually, nitrogen shortage is observed when plant nutrition is not managed properly and this element is not provided in adequate amounts, which could result in the older leaves to turn yellow and eventually, the plant's growth stops. In other cases, when too much nitrogen is provided for the plant, it normally leads to watering of protoplasm and brittleness of the plant itself which would result in becoming vulnerable to diseases and pests [4]. Use of soil microorganisms which can whether fix atmospheric nitrogen or solubilize phosphates or synthesis of growth promoting substances or by enhancing the decomposition of plant residues to release vital nutrients and increase humic content of soils, will be environmentally begin approach for nutrient management and ecosystem function [22]. Effect of inoculation on soil: Soils are one of the most important resources a farmer has. Soil health is fundamental to profitable and sustainable production and most important resource we use in agriculture. Proper management of the soil is a key to plant health and crop productivity. Soil structure has a strong impact on a range of processes in xuencing crop yield. It refers to the manner and stability with which individual sand, silt, and clay particles are bound together into units called aggregates. Soil aggregation is an important characteristic of soil fertility. Aggregates determine the mechanical and physical properties of soil such as retention and movement of water, aeration, and temperature. Aggregate formation is an important factor controlling germination and root growth [14].

The present research was done to study the effects of zeolite mineral, bio-fertilizers and different levels of chemical nitrogen fertilizer under limited irrigation water management on physiological traits of peanut (*Arachis hypogaea* L.) in north of Iran.

MATERIALS AND METHODS

In order to determine effects of zeolite minerals, bio-fertilizers and different levels of chemical nitrogen fertilizer under limited irrigation water management on yield and yield components of peanut, a field experiment was conducted at Astaneh Ashrafiyeh province. It located at the north of Iran situated at 37◦ 16' and 46◦ 56' with an average altitude of 3m above the sea level using factorial split-plot in randomized complete block design with three replications in 2010 growing season. In this study main plot was consisted of water regimes; I_1=dry land and I_2=12 day Interval Irrigation and sub factor was consisted of combination of zeolites (Z_1= 0 & Z_2=7 ton/ha), bio-fertilizers and different levels of chemical nitrogen fertilizer (N_1=0, N_2= Azospirillum + Azotobacter, N_3= 30 kg N ha^{-1}+ Aazospirillum + Azotobacter, N_4= 60 kg N ha^{-1}+ Aazospirillum + Azotobacter and N_5= 90 kg N ha^{-1}+ Aazospirillum + Azotobacter) was performed. Based on soil analysis (Table 1), phosphorous and potash fertilizer were applied for all treatments. At first, the field was submitted for a complete tillage on May 7, 2010 and followed by creating ridges and furrows, cultivation of NC2 variety seeds started. Prior to cultivation, the seeds were disinfected in 2:1000 carboxin thiram as a fungicide [2]. Crop management operations included weeding (to control weeds) and side dressing around the root. Harvest was done on September 22, 2010. Surface irrigation method used in this research was of the ridges and furrows system type where the distance between the ridges was 75 cm with the distance between plants in each ridge being 30 cm .Azotobacter and Azospirillum used in this experiment were in the form of powder containing 108 Azotobacter and Azospirillum cells per 1 gram and packed in 1 kg cases. For applying Azotobacter and Azospirillum: First, a 20% solution of sucrose was made. Powder of Azotobacter and Azospirillum was added to it and completely mixed. Second, seeds were inoculated with such mixture.

Consumed water level during the growth period was determined through measuring the amount of irrigation water and the precipitation level. In order to measure the amount of water for irrigation for each experimental unit, a contour was used. For 12 days irrigation managements, 7 irrigation frequencies was considered, respectively in which 350 mm water was consumed. To determine the total biomass (dry matter) at maturity, after excluding two rows on both sides in each plot, 12 plants were randomly selected. Then, pods, leaves and stems were placed in a 70ºC oven for 48 hours. When dried, initially, mature pods' weight for each plant was measured by the ratio of mature pods weight to the number of mature pods per 12 plants. To estimate pod yields, after the exclusion of two rows on the sides, mature pods and seeds were weighed using an accurate laboratory scale. Also to determine the plant growth rate, pod growth rate, partitioning coefficient and during growth period from pod filling following equations were used [21].

$$\text{Plant Growth Rate} = \frac{(\text{Pod yiled}\times 1.65) + \text{Biological Yield}}{\text{During growth period from planting to harvest in each plot}}$$

$$\text{Pod Growth Rate} = \frac{(\text{Pod yiled}\times 1.65)}{\text{During growth period - Day to 50\% flowering in each plot - 15}}$$

$$\text{Partitioning Coefficient} = \frac{\text{Pod Growth Rate}}{\text{Plant Growth Rate}}$$

$$\text{During Growth Period from Pod Filling} = \frac{\text{Pod Yield}}{\text{Pod Growth Rate}}$$

For variance analysis and the comparison of mean values (Duncan test, probability level of 5%) and in order to draw relevant diagrams, SAS and Excel software were used.

Table 1: Some chemical and physical properties of soil of the experimental location

Potassium (ppm)	Phosphorus (ppm)	Nitrogen (%)	pH	Organic carbon (%)	Soil texture
215	1.12	0.074	6.5	0.67	Sandy Loamy

RESULTS AND DISCUSSION

Regarding to variance analysis, crop growth rate in probable level of 1% is significant in treatment of irrigation management; amount zeolite; bio-fertilizers and different levels of chemical nitrogen fertilizer effects (Table 2). Maximum crop growth rate were obtained under 12 days irrigation management (8.11 g/m^2.day); application of 7 ton ha-1 zeolite (8.46 g/m^2.day); application 30 kg N ha-1+ Aazospirillum + Azotobacter (9.65 g/m^2.day) (Table 3). Minimum crop growth rate were obtained under dry land condition (6.08 g/m^2.day); application of 0 ton ha-1 zeolite (5.73 g/m^2.day); application control (4.54 g/m^2.day) and 0 kg N ha-1+ Aazospirillum + Azotobacter (5.46 g/m^2.day) (Table 3). True irrigation management and proper usage of amount of nitrogen fertilizer could lead to increase in groundnut growth, because by this process, level of leaves will develop and less light penetrate into soil. Therefore due to direct relation between plant growth rate and light absorption by canopy of plant, light absorption increase lead to increase in plant and crop growth rate.

Regarding to variance analysis, pod growth rate in probable level of 1% is significant in treatment of irrigation management; amount zeolite; bio-fertilizers and different levels of chemical nitrogen fertilizer effects (Table 2).

Maximum pod growth rate were obtained under 12 days irrigation management (9.68 g/m^2.day); application of 7 ton ha-1 zeolite (10.14 g/m^2.day); application 30 kg N ha-1+ Aazospirillum + Azotobacter (12.31 g/m^2.day) (Table 3). Minimum pod growth rate were obtained under dry land condition (6.48 g/m^2.day); application of 0 ton ha-1 zeolite (6.02 g/m^2.day); application control condition (4.35 g/m^2.day) and 0 kg N ha-1+ Aazospirillum + Azotobacter (5.6 g/m^2.day) (Table 3).

Regarding to variance analysis, partitioning coefficient in probable level of 1% is significant in treatment of irrigation management; amount zeolite; bio-fertilizers and different levels of chemical nitrogen fertilizer effects (Table 2). Maximum partitioning coefficient were obtained under 12 days irrigation management (1.14); application of 7 ton ha-1 zeolite (1.143); application 30 kg N ha-1+ Aazospirillum + Azotobacter (1.23) (Table 3). Minimum partitioning coefficient were obtained under dry land condition (1.006); application of 0 ton ha-1 zeolite (1.003); application control condition (0.92) (Table 3).

Regarding to variance analysis, during growth period from pod filling in probable level of 1% is significant in treatment of irrigation management; amount zeolite; bio-fertilizers and different levels of chemical nitrogen fertilizer effects (table 2). Maximum during growth period from pod filling were obtained under dry land condition (47.23 day); application of 7 ton ha-1 zeolite (46.6 day); application control condition (47.83 day) (Table 3). Minimum during growth period from pod filling were obtained under 12 days irrigation management (45.1 day); application of 0 ton ha-1 zeolite (45.73 day); application 30, 60, 90 kg N ha-1+ Aazospirillum + Azotobacter (45.5 day) (Table 3).

Table 2: Results of variance analysis for effects of zeolite, bio-fertilizers and different levels of chemical nitrogen fertilizer under irrigation water management on physiological traits in peanut

S.O.V	DF	Crops Growth Rate	Pod Growth Rate	Partitioning coefficient	During growth period from pod filling
Replication (R)	2	17.243	36.948	0.0206	0.2666
Irrigation (I)	1	62.220**	152.960**	0.2666**	68.2666**
R×I	2	0.379	1.368	0.0006	0.2666
Zeolite (Z)	1	111.248**	254.616**	0.294**	11.2666**
Nitrogen + Bacteria (N)	4	52.068**	123.715**	0.1747**	12.6666**
I×Z	1	0.3081	0.0666	0.0006	0.2666
I×N	4	2.9797	8.964	0.0037	0.2666
Z×N	4	3.4235	10.914	0.0052	0.2666
I×Z×N	4	0.9319	2.818	0.0069	0.2666
Error	36	2.504	6.005	0.0069	0.2666
CV	2	22	30	7	7.41

*ns, ** and * respectively: non significant, significant in 1% and 5% area*

Table 3: Results of means comparison effects of zeolite, bio-fertilizers and different levels of chemical nitrogen fertilizer under irrigation water management on physiological traits in peanut

S.O.V	Crops Growth Rate	Pod Growth Rate	Partitioning coefficient	During growth period from pod filling
Irrigation (I)				
I_1	6.08B	6.48B	1.006B	47.23A
I_2	8.11A	9.68A	1.14A	45.1B
Zeolite (Z)				
Z_1	5.73B	6.02B	1.003B	45.73B
Z_2	8.46A	10.14A	1.143A	46.6A
Nitrogen + Bacteria (N)				
N_1	4.54C	4.35C	0.92C	47.83A
N_2	5.46C	5.6C	1.008C	46.5B
N_3	9.65A	12.31A	1.23A	45.5C
N_4	8.3B	9.89B	1.15B	45.5C
N_5	7.5B	8.24B	1.05B	45.5C

Within each column, means followed by the same letter do not differ significantly at P<0.05

REFERENCES

[1] Barraquio, W.L,, E.M. Segubre, M.S. Gonzalez, S.C. Verma, E.K. James, J.K. Ladha and A.K. Tripathi, IRRI, Manila. Edited by Ladha JK, Reddy PM, **2000**, 93-118.
[2] Craufurrd, P.Q., P.V. Vara and R.J. Summerfield, *Crop Sci*, **2002**, 42:46-151.

[3] Curl, E.A. and B. Truelove, The Rhizosphere. Springer Verlag, Berlin-Heidelberg, **1986**, 1-288.
[4] Davoodi, MH., Nutrient Macroelements Deficiency Symptoms in Field Crop. Agriculture Education publication, **2007**, 1-144.
[5] Dwairi, IM., Environmental Geology, **1998**, 34:1-3.
[6] Egamberdiyeva, D., *Journal of Plant Nutrition and Soil Science*, **2005**, 168(1):94-99.
[7] Hallmann, J., A. Quandt-Hallmann, W.F. Mahaffee and J.W. Kloepper, *Canadian Journal of Microbiology*, **1997**, 43(10):895-914.
[8] He, Z.L., D.V. Calvert, A.K. Li and D.J. Alva-Banks, *Plant and Soil*, **2002**, 247:253-260.
[9] Kramer, PJ., John Wiley & Sons, New York, **1980**, 7-20.
[10] Mumpton, FA. Proceeding of the National Academy, **1999**, 96:3463-3470.
[11] Norman, K., L. Wieck, P. Harden and G. Baker, Peanut production guide. National Library of Australia Cataloguing-in-Publication Data, **2005**, 36.
[12] Ok, C.H., S.H. Anderson and EH. Ervin, *Agronomy Journal*, **2003**, 95:1583-1590.
[13] Rehakova, M., S. Cuvanova, M. Dzivak, J. Rimarand and Z. Gavalova, *Current Opinion in Soil State and Materials Science*, **2004**, 8:397-404.
[14] Rhawhia, A.M., T.A. El-Rahmany, B.F. Abd El-Ghany, M.M. El-Shazly and M. Morsy, *Research Journal of Agriculture and Biological Sciences*, **2010**, 6(3):228-246.
[15] Saharan, B.S. and V. Nehra, *Life Sciences and Medicine Research*, **2011**, 1-30.
[16] Smart, J., The groundnut crop: A scientific basis for improvement, London, Chapman and Hall, **1994**, 734.
[17] Sohrabi, B. and A. Behnia, *Journal of Agronomy*, **2007**, 6(3):468-471.
[18] Sohrabi, T. and Z. Paydar, Principles of Irrigation System Design. University of Tehran publication. **2009**, 406.
[19] Songsri, P., S. Jogloy, T. Kesmala, N. Vorasoot, C. Akkasaeng, A. Patanothai, C. Holbrook, Crop Science Society of America, **2008**, 48:2245-2253.
[20] Tilak, K.V.B., R.N. Ranganayaki, K.K. Pal, R. De, A.K. Saxena, C.S. Nautiyal, S. Mittal, A.K. Tripathi, B.N. Johri, *Current Science*, **2005**, 89(1):136-150.
[21] Williams, J., H. Ndungguru, D.C. Greenberg, *Journal of Agricultural Scince*, **1995**, 125, 79- 85.
[22] Wu, S.C., Z.H. Cao, Z.G. Li, K.C. Cheung and M.H. Wang, a greenhouse trial, Geoderma, **2005**, 125(2):155-166.