AENSI Journals

Advances in Environmental Biology

ISSN-1995-0756 EISSN-1998-1066

Journal home page: http://www.aensiweb.com/AEB/

Feasibility of Increased Soils Air by Using Soil Amendments

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ARTICLE INFO

Article history:
Received 15 June 2014
Received in revised form
8 July 2014
Accepted 4 September 2014
Available online 20 September 2014

Key words:
Soil air, Super absorbent, Soil amendments

ABSTRACT

The objective of this study was to examine the effect of different rates of Tarawat super absorbent on increasing of clay soils air. The study was carried out using a completely randomized block design with three replications, with 1.5*1.5 m plots, in research field of Islamic Azad University, Yadegar-e-Imam Khomeini (RAH) Branch. The treatments of the experiment were super absorbent in six levels including 0 (control), 0.05, 0.15, 0.30, 0.45 and 0.60%w/w. The results of variance analysis showed that various super absorbent rates, had significant effects on the amount of soil air, total and capillary soil porosity ($pr \leq 0.01$). Means comparison (based on LSD test), showed that there is a significant difference ($p_r<0.01$) between different levels of super absorbent usage and control, in augmentation of soil air, total and capillary soil porosity. Also the results showed, the use of 0.6% w/w super-absorbent increased total porosity to 75.1% which included 46.1% and 28.9%, capillary porosity and air porosity, respectively. According to the statistical analysis and economical facts, application of 0.05 to 0.15 % super absorbent is recommended to improve structure of clays soils and increasing aeration in these soils.

To Cite This Article: Kamran Parvanak and Hadi Chamheidar., Feasibility of increased soils air by using soil amendments. ***Adv. Environ. Biol., 8(12),*** *873-875, 2014*

INTRODUCTION

One of the problems of clay soils is the low rate of air the soil [2]. The super- absorbent are hydrophilic polymer hydrogels that formed of much smaller molecules bounded together (monomer) [11]. The good properties of these super-absorbent in terms of absorbent, rate of absorbent, gel strength and inexpensive of acrylic monomer cause attractiveness of these super-absorbent families. Super-absorbents are not toxic and depending on their type degraded in soil by microorganisms after 3 to 7 years [7]. Also the super-absorbents are odorless, colorless and have neutral acidity and non-pollutant in soils, surface and ground water and plant tissues [1]. Ganji-Khoramdel, with applying the values of 0.3%w/w of PR3005 A polymer in a loam soil under laboratory condition, increased the soil air to 2 times [5]. Research conducted by Karimi *et al*., with a hydrophilic material Igita about the growth and development of soybean and sunflower indicated that the addition of Igita to various soils increased soil moisture and available water and the effect of this substance on growth and plant height was positive. His results showed that amount of all porosity types, particularly capillary porosity increased compared to control [6]. Polyacrylamide hydrogels are effective in forming stable aggregates in soils. To increase the stability of soil structure, grain or dried hydrogels were mixed with soil or soil samples are added to the hydrogel solution. Roa showed that by adding 60 kg/ha polyacrylamide to uncultivated sandy loam soil, the porosity of sprinkler and flood water levels are significantly higher than the control soil, but the mass bulk density was lower. He also reported that aggregate stability was increased from 17 to 80 percent, and the stability lasted during the experiment [8]. Soyjka and Lentz and El-Hady *et al*., found that the use of super absorbent polymer in the furrow irrigation, increased air porosity rates up to 50 percent [10,4]. So the main objective of the present study was to investigate the effect of different rates of Super-absorbent on improve total porosity, air porosity and capillary porosity in clay soils.

MATERIALS AND METHODS

To achieve the desired objectives in this study, an arable land with light textured of University Research Farm was elected and was plow and disc to a depth of 30 cm. After sampling, Physical and chemical properties of the samples was measured according to standard methods [3]. In plowed plots, six plots with dimensions of

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1.5 × 1.5 m and a distance of 1 m between them were established in three replications. The super-absorbent treatments (including zero 0.05, 0.15, 0.30, 0.45 and 0.60% w/w) for each plot based on a completely randomized block design with three replications, manually split evenly on each plot and was mixed with soil to a depth of 30 cm. The amount of irrigation water was calculated based on 50% moisture depletion allowance for clay soil and the water was poured into the watering can and were distributed in each plot. Irrigation was performed as above for about six months. In the last of irrigation, from three points within each plot was sampled using the sampling cylinder to determine the air, capillary and total porosity. The said characteristics were measured according to standard methods [3]. Statistical analysis of the data was performed by analysis of variance (ANOVA), comparing the mean by the LSD method with using SAS and drawing diagrams by EXCEL.

RESULTS AND DISCUSSION

Physical and chemical characteristics of the studied soil:

Soil physical and chemical analysis results are listed in Table 1. The texture of the studied soil is clay. Its bulk density and saturated hydraulic conductivity were measured 1.41 g cm-3 and 0.12 m day-1, respectively.

Table 1: Physical and chemical characteristics of the studied soil.

Soil texture	Buck density (g cm^{-3})	Particle density (g cm^{-3})	Porosity (%)	Saturated hydraulic conductivity (m day^{-1})	Water content (%)		pH	EC (dS m^{-1})
					FC	PWP		
clay	1.41	2.69	48.1	0.12	30.1	21.5	7.15	2.2

Effects of super-absorbent application on soil air, capillary porosity and total porosity:

The ANOVA results of effect of different super-absorbent levels on soil air, capillary porosity and total porosity augmentation is shown in Table 2. As the results show there is significant difference between levels of super-absorbent level in the increasing of soil air, capillary porosity and total porosity (pr≤ 1).

Table 2: Analysis of variance of the effect of different rates of Super-absorbent on total porosity, air porosity and capillary porosity.

Mean of square				
SOV	Df	Total porosity (%)	Air porosity (%)	Capillary porosity (%)
Super-absorbent rate	5	307.410**	72.152**	80.349**
Error	10	0.073	0.059	0.366
*,** Significant at P=0.05 and P=0.01 levels, respectively.				

The results of mean comparison of the application of super-absorbent values on total porosity, air porosity and capillary porosity are shown in figure 1. The following results are obtained from interpretation of these figures.

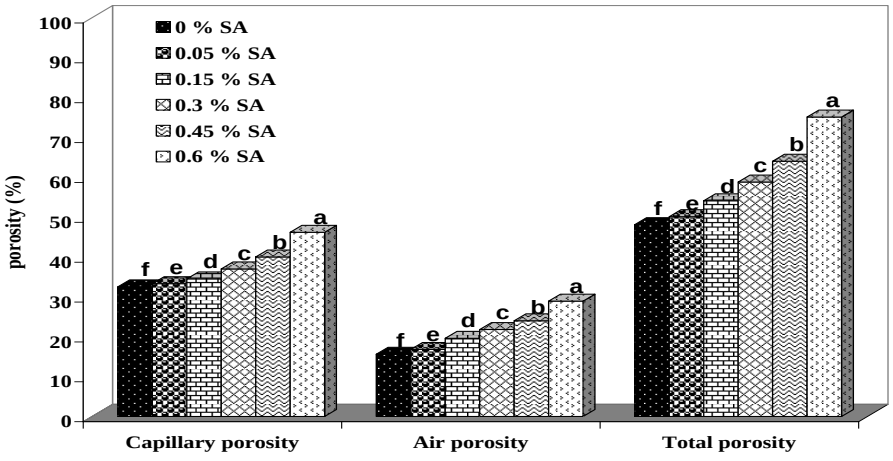

Fig. 1: Changes in soil porosity types.
(Bars within a porosity class having the same letter are not different at P = 0.01).

1) Base on the mean comparison LSD approach (Fig. 1), there are significant difference between the mean total porosity, air porosity, capillary porosity and control treatments and also between different levels of super-absorbent (pr≤ 1). The 0.6 and 0.45% rates of super-absorbent had the highest effect on total porosity, air porosity, capillary porosity of the soil, respectively. The results of this study are consistent with the results of the investigation of ROA and Karimi *et al*., [8,6].

2) Application of super-absorbent in clay soil and increasing the rate of it may increase porosity types (total porosity, air porosity and capillary porosity). The general trend is an increase in soil porosity types and the process becomes more from 0.15% super-absorbent up to 0.60% (Fig. 1).
3) The use of 0.6% w/w super-absorbent increased total porosity to 75.1% which included 46.1% and 28.9%, capillary porosity and air porosity, respectively (Fig. 1). This shows that in clay soils that there is major air porosity and drainage problems, application of the super-absorbents increase air porosity to 55% and provides more ability to for gas exchange in the soils.

Conclusion:

According to the results of statistical analysis and considering the economic aspect, the addition of super absorbent Tarawat at low levels (0.05 to 0.15% w/w) recommended in order to improve air of clay soils.

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