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Evaluation the Effects of Superabsorbent on Qualitative Characteristics of Lawn

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Abstract

Water sources optimizing required a suitable irrigation program. Different material can use to increase water use efficiency. Superabsorbent is one of the materials where used in around the world. These materials put in the soil and absorb water so that reserved water is usable by plant in the time of drought stress and they can reduce stress and lead to prevent yield loss. Therefore, the experiment was conducted to evaluate effects of different superabsorbent and irrigation cycles on lawn. A split plot experiment based on randomized block design with three replications was used. Irrigation cycles and superabsorbent amounts used as main-plot and sub-plots respectively. Four irrigation periods (1, 2, 4 and 6 days) and four superabsorbent amounts (0, 20, 25 and 30 g/m^2) were used as experimental treatments. One-day irrigation interval and zero superabsorbent amounts were used as control. Lawn water requirement was calculate by evaporation from a pan class. Results showed that superabsorbent amount had significant effect on shoot height, total chlorophyll and plant density. Results showed that lawn performance was higher in 30 g/m^2 of superabsorbent amount at two-day irrigation cycle.

Keywords: Irrigation cycle, Lawn, Qualitative characteristics, Superabsorbent.

INTRODUCTION

The lawn is a main and essential part of parks and gardens (Allahdadi, 2003 and Falahian, 2002). Landscape extension requires sufficient water source, while Iran located in arid and semi-arid area (Kabiri, 2003). Accurate management on soil and water can aid to correct applying and saving the rainfall and other narrow source of water (Ghanji Khoramdel, 2003). It is necessary to plan a program for suitable providence of water. Therefore, some amendment materials such as superabsorbent polymer (SAP) can increase the efficiency of coefficient agriculture water. These polymers can absorb amounts of rainfall and irrigation water, save a runoff and then dispose again on arid condition. Superabsorbent applying in the landscape can decreases costs and irrigation amount. The material can decreases a drought stress, because they can absorb water until 400 upper their weight (Allahdadi, 2003 and Khoshnevis, 2003). Limited water sources shows necessity of water providence. Proper management and methods for soil humidity saving is effective method to increase the irrigation potential (Shafiei, 2003 and Ghanji Khoramdel, 2003). The research on the growth of Tampson seedling showed SAP applying in the soil increases soil absorption capacity (Shirdel Shahmiri and Akbari Todehi, 2009). Growth and coloring in the leaf of lettuce increased with using a 0.3% amendment material (Karimi, 1994). 0.3% w/w SAP applying in olive trees caused to increase growth index in seedling in arid stress (Talaee and Asadzade, 2006; Gholpayeghani Mojtahed *et al*., 2009). SAP applying in *Brassica napus* cause to decrease water deficient and save water and showed increasing yield (Tohidi-Moghadam, 2009). SAP applying in sandy soil increased field capacity (Johnson, 1984). Therefore, this study evaluated the SAP applying effect on the qualitative characteristics of lawn.

MATERIALS AND METHODS

This study carried out at June 2008 in the Ilam province. Applied seed was sport mixture lawn. Any irrigation treatment did not make until complete establishing of plants. This trial conducted as a split plot experiment based on randomized block design with three replications. So irrigation cycles and superabsorbent amount used as main-plots and sub-plots respectively. First factor was irrigation periods (1, 2, 4 and 6 day interval) and second factor was superabsorbent amounts (0, 20, 25 and 30 gm^{-2}). Meantime one-day irrigation interval and without superabsorbent were used as control. Irrigation did by hand after evaporation calculating by pan class A. The used soil amendment was a hydrophilic polymer, Superabsorbent A200, produced by Rahab Resin Co. Ltd., under license of Iran Polymer and Petrochemical Institute. Some traits including; shoot height, lawn density, root length, root and shoot fresh and dry weight and total chlorophyll were evaluated on growing season. Shoot height recorded on the 5, 10, 15 days after seedling emerge. Lawn coerage power (tillering power) estimated by numbering of tillers of a seedling in the area 100 cm^2. Leaf and root dry weight obtained after oven drying for 24 h at 70°C. Chlorophyll content estimated based on Mostofi and Najafi (2006) method.

Data analysis of variance was performed through MSTATC and mean comparison was done with Duncan's multiple range test. Drawing graphs was done by using Microsoft Office Excel software.

RESULTS AND DISCUSSION

Shoot Height

Based on ANOVA (Table 1), irrigation period and superabsorbent amount had significant effect on shoot height at 1% and 5% respectively. Results showed that the highest shoot height was obtained under treatment a_2b_3 (2-day irrigation interval and 25gm^{-2} superabsorbent). Therefore, the least growth (18.33 mm) was observed under a_4b_1 (6-day irrigation interval and without superabsorbent). Based on researches, super absorbents applying can cause to increase in plant growth indices such as plant height. Esmaeili and Sheikhmoradi, 2009, on *Zea mays*, Allahdadi *et al.*,

2006, on lettuce, Nicorazm *et al*., 2009, on wheat, Stern *et al*., 1992, on lawn and Panayiotis *et al.,* 2004 found similar results in their researches.

Root Developing

The data analysis variance showed that irrigation period has significant effect on the root-developing (Table 1). While, superabsorbent amounts did not significant effect on root development (Table 1). Data mean comparison revealed that maximum root developing was attained under treatment a_3b_3 i.e. 4-day irrigation interval and 25 gm^{-2}.

Root development and depth increases with irrigation interval increasing and it decreases in high interval (Panayiotis *et al*., 2004; Mosavinia and Atapour, 2006).

Fresh Root Weight

The data analysis variance (Table 1) showed that irrigation period influenced significantly fresh root weight. However, amount superabsorbent and interaction irrigation period and superabsorbent did not have significant effect on fresh root. Average comparison of data showed (Table 2) maximum fresh root weight was obtained under treatment a_1b_4 (1-day irrigation interval and 30 gm^{-2} superabsorbent) and lowest fresh root weight belonged to a_3b_4 (four or 6-day irrigation interval). Based on researches, superabsorbent can be increase fresh root weight in tomato and melon (Kokhaei, 2002).

Root Dry Weight

The analysis variance showed that irrigation period affected significantly dry weight of root. Nevertheless, superabsorbent amount and the experimental factors interaction did not have significant effect on root dry weight (Table 1). Average comparison of data showed (Table 2) maximum root dry weight was obtained under treatment a_1b_4 (1-day irrigation interval and 30 gm^{-2} superabsorbent) and lowest root dry weight belonged to a_4b_3 (6-day irrigation interval and 25 $g.m^{-2}$).

We observed that in short interval irrigation (1 or 2-day interval) root dry weight raised by increasing superabsorbent amount. According the studies, applied superabsorbent can increase root dry weight in some plants such as *Populous euphratica* and wheat (Woodhouse and Johnson, 1991; Shafiei, 2003). Increasing applied superabsorbent caused to raise dry weight of oil cotton (Kokhaei, 2003).

Shoot Fresh Weight

The data analysis variance showed irrigation interval had significant effect on shoot fresh weight ($p\leq0.01$), but the effect of superabsorbent amount and interaction of experimental factors did not influenced fresh weight significantly (Table 1). Based on comparison data mean (Table 2), the most amount of shoot fresh weight belonged to treatment a_2b_3 (1-day irrigation interval with 25 gm^{-2} superabsorbent) and a lowest content obtained under 6-day irrigation interval without superabsorbent applying (a_4b_1). Other trial results showed superabsorbent can cause to increases shoot fresh weight on tomato and melon (Salar *et al.*, 2006). Hydrophilic polymer, Terracottem, caused to increase biomass of melon.

Shoot Dry Weight

The effect of irrigation interval and amount of superabsorbent were not significant on shoot dry weight (Table 1). Based on data mean comparison (Table 2) the most amount of dry weight obtained under treatment a_2b_3 and minimum amount belonged to treatment a_4b_1. Superabsorbent applying caused to increase wheat dry weight (Johnson and Woodhouse, 1990).

Total Chlorophyll

The analysis variance of data table (Table 1) showed that irrigation interval and amount of superabsorbent affected total chlorophyll significantly ($p\leq0.01$). Evaluation of interaction effect showed that maximum total chlorophyll related to a_2b_1 and the lowest amount obtained under treatment a_4b_4. However, total chlorophyll depends on irrigation interval. Mosavinia and Atapour (2006) found that increased superabsorbent cause to the color increasing. Other research showed that amendment applying causes to increase color of leaves (Karimi, 1994). Field capacity and wilting

point distance was increased under superabsorbent applying (Woodhouse and Johnson, 1991; Taylor and Halfacre, 1986). Tohidi-Moghadam, (2009) and Kant *et al*., (2008) found the similar results in *Brassica napus* and broad bean.

Density

The Data analysis of variances showed that effects of irrigation interval and superabsorbent were significant on density of plant. Irrigation interval and superabsorbent interaction influenced significantly lawn density. The highest density belonged to a_4b_1 i.e. one-day interval irrigation with 30 g superabsorbent. Minimum plant density was obtained under a_4b_1 treatment (6-day irrigation interval without superabsorbent). Based on scientific reports, superabsorbent can increase plant density in lawn, *Pinus halepensis* and *Populous euphratica* (Woodhouse and Johnson, 1991; Shafiei, 2003). We found that increased superabsorbent amount with short irrigation interval can increase lawn density. Mosavinia and Atapour (2006) reported that plant density increased under superabsorbent 100 g/m^2 applying. Finally, 30 g/m^2 superabsorbent applying can increase irrigation interval to 2-day.

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Tables

Table 1. Analysis of variance table of treatment effect on experimental plant traits.

Source of Variables	df	Plant height	Root depth	Root fresh weight	Root dry weight	Shoot fresh weight	Shoot dry weight	Total chloro-phyll (a+b)	Density (100 cm²)
Irrigationinterval(A)	3	329.9**	31.25*	0.03*	0.004**	15.3**	0.113 ns	0.31**	537.1**
Error	6	11.5	3.9	0.001	0.001	0.111	0.03	0.001	1.38
Superabsorbent(B)	3	0.74 ns	4.8ns	0.001ns	0.001ns	0.14 ns	0.013 ns	0.001**	26.6*
AB	9	2.25*	6.8ns	0.001ns	0.001ns	0.245 ns	0.006 ns	0.001*	17.17*
Error	24	3.7	8.4	0.001	0.001	0.651	0.02	0.001	27.26
CV%	-	7.64	11.74	4.89	11.04	8.93	9.87	2	4.06

**,* and ns means significant at 1%, 5% and non-significant respectively

Table 2. Data mean comparison of treatments effect on experimental traits.

Treatments	Plant height (cm)	Root depth (mm)	Root fresh weight (g)	Root dry weight (g)	Shoot fresh weight (g/5cm²)	Shoot dry weight (g/5cm²)	Total chlorophyll (a+b) (ml/g)	Density (100cm²)
a_1b_1	27.7 a	22.33 c	0.44 bcd	0.11 ab	9.6 a	1.38 abc	0.37 cde	130 abcde
a_1b_2	28 bc	23.33 c	0.45 abc	0.11 ab	9.6 a	1.5 ab	0.36 cdef	137 abc
a_1b_3	28.7 abc	23 abc	0.48 ab	0.12 ab	9.8 a	1.5 ab	0.39 bc	137.3 ab
a_1b_4	28.33 bc	23.67 bc	0.51 a	0.13 a	9.8 a	1.5 ab	0.38 cd	138 a
a_2b_1	30.7 abc	26.33 abc	0.40 cde	0.09 ab	9.7 a	1.47 abc	0.46 a	132.7 abcd
a_2b_2	30 abc	22.33 c	0.40 cde	0.09 ab	9.8 a	1.5 ab	0.43 ab	131 abcde
a_2b_3	31.76 a	25 abc	0.40 cde	0.10 ab	10 a	1.6 a	0.45 a	133 abcd
a_2b_4	31 ab	25 abc	0.40 cde	0.11 ab	10 a	1.5 ab	0.43 ab	133 abcd
a_3b_1	22.7 d	25.67 abc	0.36 e	0.08 ab	9.6 a	1.4 abc	0.38 cd	127 bcdef
a_3b_2	22.33 de	28.33 ab	0.36 e	0.08 ab	9.2 ab	1.4 abc	0.37 cde	127 bcdef
a_3b_3	21.33 def	28.67 a	0.37 de	0.08 ab	8.7 abc	1.4 abc	0.37 cde	124 defg
a_3b_4	21 def	25 abc	0.35 e	0.08 ab	9.23 ab	1.4 abc	0.36 cdef	127 bcdef
a_4b_1	18.33 f	25 abc	0.35 e	0.08 ab	6.9 c	1.2 c	0.32 ef	117.3 g
a_4b_2	20.7 def	24 abc	0.38 de	0.09 ab	7.7 bc	1.3 bc	0.32 ef	122.3 efg
a_4b_3	19.33 ef	25.33 abc	0.37 de	0.07 c	7.3 c	1.4 abc	0.33 def	118.3 fg
a_4b_4	20.33 def	22.33 c	0.37 de	0.08 ab	7.6 bc	1.3 bc	0.32 f	123.7 defg