INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 4, No. 4, p. 18-23, 2014

RESEARCH PAPER OPEN ACCESS

The effects of superabsorbent polymer on yield and yield component of two grape varieties

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Key words: Grape, super absorbent, variety, yield.

http://dx.doi.org/10.12692/ijb/4.4.18-23 Article published on February 20, 2014

Abstract

In other to study the effects of superabsorbent polymer on yield and yield component of grape varieties a field experimental was conducted in Badranlo region of Bojnourd at 2011 season crop. The experimental design in this research was factorial using randomized complete block design (RCBD) with four replications. Factor A was comprised of two genotype of grape G_1: Kolahdary and G_2: Shastaros and factor B was superabsorbent polymer treatment S_1: poly acrylat potassium and S_2: control. Measured characters was grain weight, grain length and grain diameter, panicle length, panicle numbers in the bush, grain numbers in panicle, weight of panicle and fruit yield. Obtained results of this study show that Superabsorbent treatments significantly affected yield, panicle weight, Number of single grape in panicle, Number of panicle in bush and Panicle length of grape variety. Maximum amount of all these characters was recorded in G1S1 (consuming superabsorbent + Kolahdary variety) and lowest average was obtained in G2S2 (control)

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Introduction

In arid and semiarid regions of Iran, serious water deficits and deteriorating environmental quality are threatening agricultural productivity and environmental sustainability. The available water in soil is one of the most important factors of increasing crop yields (Ghooshchi *et al.*, 2008). One of the materials which have been used in these years recently, and different researches which have been conducted on it in different field of agriculture, are super absorption polymers. Researcher have achieved to positive results about them in their research. Thus, there is an increasing in using water-saving superabsorbent polymer. Super absorbent polymers are compounds that absorb water and swell into many times their original size and weight. They are lightly cross-linked networks of hydrophilic polymer chains. The network can swell in water and hold a large amount of water while maintaining the physical dimension structure (Mahdavinia *et al.*, 2004).

Super absorbent polymers by increasing the capacity of water storage in soil (Akhter *et al.*, 2004; Sarvas *et al.*, 2007), reduction of wasting water and nutrition materials of soil (Adams and Lockaby, 1987), reduction of water evaporation from the surface of soil (Akhter *et al.*, 2004; Sarvas *et al.*, 2007; Sivapalan, 2001) and increasing the aeration of soil (Orzeszyna *et al.*, 2006) causes the better growth and enlargement of plants and as a result, increase the yield under normal irrigation and water stress condition. The combination of super absorbent polymer and fertilizers, i.e., incorporating fertilizers and Superabsorbent polymers in a single formulation named as water-absorbent slow release fertilizer is a trend in international fertilizer research, (He *et al.*, 2006; Ye *et al.*, 2000; Zhou 2003; Wang *et al.*, 2005; Li, 2003; Karadag *et al.*, 2000). Compared with traditional adsorbents such as the silica gels, aluminas and the activated carbons (Kunin, 1976), the polymeric adsorbents are viewed as a more attractive alternative for the controllable pore structures and surface characteristics, for example, the commercially available Amberlite XAD-4 resin was reported as an ideal adsorbent for a wide variety of aromatic compounds, especially for phenols (Xu *et al.*, 1997). Huttermann *et al.* (1999) reported that adding super absorbent polymer to sandy soil, increase the capacity of water storage in soil and the Pinus halepensis seedling treated with super absorbent polymer in the process of drought stress, showed a better stability and growth in compare with seedling used control treatment (without super absorbent).

Blodgett *et al.* (1993) found that adding Superabsorbent polymers to the soil matrix increased the water holding capacity as well as water available to plants. The use of hydrophilic polymers in soils to improve both the nutritional and water status of plants has attracted considerable interest recently. When used correctly, SAP have the potentials to improve soil physical properties, reducing soil erosion and nutrient loss, and improving runoff water quality (Shainberg *et al.*, 1994), aiding seed germination and emergence (Azzam, 1983), increasing seedling survival (Gray, 1981), increasing crop growth and yield (Yazdani *et al.*, 2007) and reducing the irrigation requirement for plants (Flannery and Busscher, 1982). Results of Yazdani *et al.* 2007 on soybean showed that application of superabsorbent polymer under drought stress causes the increase of grain yield and the total dry weight of soybean. Aim of this research is investigation effect of super absorbent polymers on three grape varieties in Badranlo region of Iran.

Material and methods

Field experiments

This experiment was conducted during 2010 and 2011 cropping season in a grape orchard at Badranlo region. The site lies at longitude 57˚5, and latitude 37˚32 and the altitude of the area is 1020 m above sea level. The experimental design in this research was factorial using randomized complete block design (RCBD) with four replications. Factor a was comprised of two genotype of grape G_1 : Kolahdary and G_2 : Shastaros and factor B was comprised of two superabsorbent polymer S_1: poly acrylat potassium

and S_2: Control. Grape trees (*Vitis vinifera*) in a private orchard at Badranlo region of Bojnourd, having 50 years old, grown in loamy clay soil. Distance between trees was 2.5 m and between trees rows was 2.8 m, there were 20 trees in each row. Under drip irrigation system, similar in growth and received common horticulture practices, were selected for this investigation. Every testing plot in field included 4 rows with length of 6 m and distance of 2.5 m between rows and 2 m distance grape trees. 40 g of super absorbent polymer applied for each row (equal to 110 kg/ha) in depth of 15 cm for super absorbent treatment. Irrigation of plots performed regularly when 75 and 40% of moisture evacuated from soil in stress and normal plots respectively. At the time of ripping crop, was selected 5 bushes from each plots accidently for measuring consider factors, and the quantitative factors .Measured characters was grain weight, grain length and grain diameter, panicle length, panicle numbers in the bush, grain numbers in panicle, weight of panicle and fruit yield (fruit yield was measured when grain reached physiological stage. The harvested area for each plot was 2.4 m^2).

Statistical analysis

The yield Statistical analysis of data was done by statistical software of SAS (Release version 9). Comparison of means was done through Duncan method. In order to compare treatment groups orthogonal comparison method was used.

Result and discussion

The result of analyzing data variance in table 1 showed that the cultivar effect on all of measured quantitative factors was significant (P<0/01). Also the effect of super absorbent polymers had a significant effect on all factors except single grain weight, the length of single grain, diameter of single grain. Obtained results showed that the interaction effect of cultivars and super absorption was significant (P<0/05) except the factors of single grain weight, single grain length and single grain diameter on other quantitative factors. The mean comparison of data in table 2 showed that among both cultivars, Kolahdari obtained the highest amounts of panicle length, panicle numbers in the bush, grain numbers in panicle, the average of single grain weight ,the weight of each panicle and fruit yield, but the highest amount of seed length factor was seen in Shastaroos cultivar. It shows that Kolahdari cultivar have high product ability on the condition of Badranloo region. These results are in agreement with the findings of He *et al*., (2006). The reason of being of yield in Kolahdari cultivar is promotion of this cultivar at the most of its yield instruction rather than Shastaroos cultivar. The mean comparison of data about super absorption treatment showed that the usage of super absorbent polymer causes to increase the yield of grape in compare to control treatment as shown in table 2. Results in this section showed that use of super absorbent cause to increase the yield of grape rather than control treatment in amount of 23/06%. Among yield component of grape cultivars use of super absorption cause to increase gained amounts of panicle length, the number of panicle in the bush, the number of single grape in panicle and the weight of panicle rather than control treatment. This result corroborated the earlier findings of Azzam, 1983. The mean comparison of interaction effects data shows that highest amount of grape yield was considered by average of 2299 Kg/ha in G_1S_1 treatment. These results show that Kolahdari cultivar has more productive ability rather than Shastaroos cultivar. By use of super absorbent, the amount of yield increasing has been increased in higher amount. As it considered G_1S_1 treatment has a yield rather than G_2S_2 in amount of 48.45%. In factor of panicle length, the highest amount was seen in G_1S_1 treatment and the lowest of it was seen in G_2S_2 by the average of 113 and 83 cm respectively, when there have no significant difference among treatments of G_1S_2, G_2S_1 and G_2S_1, statistically. This result corroborated the earlier findings of Yazdani *et al*, 2007 and Gray, 1981. In this factor, super absorbent in Kolahdari cultivar increases the length of panicle to 26.55% rather than control treatment. The highest amount of panicle number in the bush, the number of single grape in the panicle and the weight of single grape in G_1S_1 treatment obtained among other measured factors with amounts of 91 and 36, 91 and 5.09 gr

respectively. The grape of Kolahdari cultivar was better than the factors of panicle length, panicle number in the bush, single grape number in panicle, the weight of each panicle and yield, and also from the quantative factor of single grape length of Shastaroos cultivar was better than Kolahdari cultivar as shown in table 2. These results are in line with the findings of Yazdani *et al*, (2007). According to the recorded results of mean comparison data of measured quantitative factors, the Kolahdari cultivar was better than the Shastaroos cultivar in the length of panicle, the number of single grape in panicle, the single grape weight and yield of grape. According to the obtained results, Kolahdari cultivar was better than Shastaroos cultivar from the most of quantitative factors in Badranloo, as the use of super absorbent had a significant effect on yield increase in both of cultivars. The effect of using the matter of super absorption had higher on improvement of the most quantitative factors of the grape of Kolahdari cultivar rather than Shastaroos in Badranloo (Table 2).

Table 1. Analysis of variance for yield and yield components.

S.O.V	Yield	Panicle weight	Single grape diameter	Single grape length	Single grape weight	Number single grape panicle	Number of panicle in bush	Number of panicle in length
Replication	40070 ns	719 ns	0.005 ns	0.02 ns	0.07 ns	24.23 ns	5.83 ns	82.23 ns
Variety	16744360**	24570**	1.126**	2.37**	0.45**	17.1**	121*	431**
Superabsorbent	78588225	17.889**	0.087ns	0.09 ns	0.72 ns	189 **	30.25**	1463**
Sb×Va	4536900 *	138 *	0.002 ns	0.001 ns	0.008 ns	7.56*	2.25*	2.32*
Error	915503	385	0.0040.03		0.05	13.73	1.11	52

*, ** significantly at the 5% and 1% levels of probability respectively and ns (non significant).

Table 2. Mean comparison effect of variety and superabsorbent on yield and yield components of grape.

Treatment	Yield (Kg/ha)	Panicle weight (gr)	Single grape diameter (cm)	Single grape length (cm)	Single grape weight (gr)	Number of single grape in panicle	Number of panicle bush	Panicle inlength (cm)
Kolahdari	20236a	423a	1.6 a	2.4b	4.85a	87a	34a	99a
Shastaros	13766b	345b	1.38a	3.17a	5.19a	67b	29b	89b
Superabsorbent	19218a	417a	1.54a	2.87a	5.23a	80a	33a	104a
Control	14785b	351b	1.4a	2.7a	4.8a	73b	30b	85b

Table 3. Mean comparison interaction effect of variety and superabsorbent on yield and yield components of grape.

Treatment	Yield (Kg/ha)	Panicle weight (gr)	Single grape diameter (cm)	Single grape length (cm)	Single grape weight (gr)	Number of single grape in panicle	Number of panicle bush	Panicle inlength (cm)
G1S1	22990 a	459.5 a	1.64 a	2.47 a	5.03 a	91 a	36 a	113 a
G1S2	17490 b	386.8 b	1.47 a	2.33 a	4.65 a	83 b	32 b	86 b
G2S1	15450 c	375.3 b	1.44 a	3.25 a	5.54 a	65 c	30 c	95 b
G2S2	12080 d	314.3 c	1.31 a	3.08 a	4.95 a	64 c	28 d	83 b

Conclusion

It seems that the matter of super absorption in the grape of Kollahdari cultivar had more effect than Shastaroos cultivar by creating more vegetative growth, for providing the improved conditions and photothynsis increase by producing more green coverage by producing higher number of panicle in the bush and by increasing the number of single grape

in panicle and increase the length of grape single grape in increasing the yield of Kolahdari cultivar had more effect than Shastaroos cultivar And the positive effect of super absorption caused to increase the yield factors of the grape of Kolahdari cultivar such as panicles growth increase of panicle numbers in the bush and the numbers of single grape in the panicle.

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