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Effects of (PR 3005 A) superabsorbent polymer on water consumption and some quantitative and qualitative characteristics of flax (*Linum usitatissimum*)

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Abstract

The experiment was conducted to investigate the effect of superabsorbent polymer (PR 3005 A) on water consumption of flax plant. The treatments including polymer (0, 500 and 1000 kg/ha) and irrigation depths (7.5 and 10 mm) as randomized complete block in split plot design with three replications. The experiment was carried out in agricultural research station, Zahak, Zabol, Iran. The results of experiment showed that application of polymer could improve water maintenance in sand soil. More polymer consumption resulted in higher plants, more number of branches and flower in shrub and more dry matter, significantly ($P< 0.01$). These results were seen in flax plant before and after flowering that emphasized the great effect of polymer in the improvement of flax growth properties.

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Introduction

Iran is located in arid and semi-arid region which not only has low natural falling, but also the raining is not equally distributed. The main part of water is consumed in agriculture. Regional reports emphasized the necessity of water saving, strongly. One of the methods in reducing water consumption is increasing water optimization. It means that proper management of water through water maintenance, increasing water capacity, improvement of infiltrability water in soil and could led to increase of water optimization in agricultural systems. Application of some improvement compounds like perlit and polymers is some methods in achieving these aims. In fact, the polymer like PR 3005 A could improve physical properties of soil which growth of plants could occur through its application. It is reported that addition of Igita to soil improved physical properties of soil and increased growth of sunflower and soybean. More porosities, water maintenance capacity and growth of plant were attributed to application of Igita (karimi, 1993).

Pour Esmaili *et al* (2006) in a study conducted on red bean plant, found that drought stress reduces grain performance, biological performance, harvest index and hundred-grain weight and increases activity levels of antioxidant enzymes such as catalase, superoxide dismutase and Glutamine peroxidase, in the case that consumed Super absorbent polymer reaches to 7%, due to reduction in drought stress impact, grain yield, biologic performance ,harvest index and hundred-grain weight will be increased and activity of these enzymes will be decreased.

The water- holding capacity of light soils could increase after incorporation with super absorbent polymers (Asgari *et al*., 1993). In fact, the super absorbent polymers could tolerate the amount of water much more than their weights and maintain for a long time. So application of them could be a promising approach in agricultural systems. It is reported that application of polymers increased irrigation intervals (Allahdadi, 2002). Also, better performance of fertilizers and activity of microorganisms would occur in soil due to increasing air content. Regarding the location of Iran aspect of climate features and potential of Iran in the field of culture of medicinal plant, it seems that finding new approaches for achieving water optimization is necessary. Also, from the authors' knowledge there is no sufficient data on application of superabsorbent polymer on water consumption of flax plant, so this experiment was performed to investigate effect of polymer PR 3005 A on qualitative and quantitative properties of flax in two level of irrigation amount.

Material and methods

Experimental site

The experiment was performed in agricultural research station of Zabol, Iran which located in semi-arid area with relative raining of 274.4 mm in the year.

Field preparation and treatment

Regarding the importance of polymer in soil and its effect on physical and chemical properties of soil, different level of polymer including 0, 500 and 1000 kg/ha was added to soil, then the samples from depth of 0-30 cm was taken and submitted to irrigation laboratory of Technical and Engineering Research Institute, Iran for further analysis which included electrical conductivity, pH, cations and anions of soil solution. Also, texture, spit saturation, apparent specific weight of soil, actual density of soil, porosity and humidity curves of samples were defined.

Effect of Superabsorbent polymer PR 3005 A on growth of flax

In the second experiment, effect of Superabsorbent polymer PR 3005 A on growth of flax was conducted in randomized complete block as split plot design with three replicates. The main plot was irrigation level (10 and 7.5 mm which were equal to not pure require of irrigation and 0.75 of not pure require of irrigation, respectively) and sup plot was polymer levels (0, 500 and 1000 kg/ha). The polymers were added to the depth of 0-20 cm of soil, and then the seeds were cultured. Then, all of plots were irrigated and the weeds were removed manually. The times of

irrigation were defined as n=55 according to FAO (FAO, 24). So the volume of water for treatment of irrigation depth of 10 and 7.5 were 5500 and 4125 m3/ha, respectively.

Statistical analysis

The collected data were subjected to analysis of variance using SAS ver. 9 software and the means were separated using Duncan Multiple Range Test ($P< 0.05$) where F value was significant.

Results and discussion

Results of experiment showed that before flowering application of polymer increased number of branches in plant, height and dry matter of flax compared with control. Also, more level of polymer resulted in higher records of these features (Table 1). Similar results were obtained in application of different level of polymer after flowering. Number of branches in plant increased following application of polymer and highest number was obtained when polymer used at level of 1000 kg per hectare (n=9.2). The height of flax increased after polymer application as well as dry matter (Table 1). DeanYonts (2006) examined the effect of polyacrylamid (Stockosorb AGROF) following different irrigation methods on seed germination of sugar beet plant. They found that application of polymer in furrow method enhanced plant emergence Parvanak Boroojeni (2009) reported similar results aspect of well potential of super absorbent polymer on enhancement of total available water on plant.

Table 1. Effect of different polymer levels (0, 500 and 1000 kg/ha) on properties of flax before and after of flowering.

treatments	Before flowering			After flowering		
	Number of branches in plant	Height	Dry matter	Number of branches in plant	Height	Dry matter
P0	6.5 b	29.3 c	18.8 b	6.83 b	47.1 c	22.6 b
P5	8 ab	35.5 b	23 b	8.5 ab	54 b	25 b
P10	8.8 a	42.3 a	34.5 a	9.5 a	65.3 a	37.3 a

In each column, the means with similar letter had no significant difference according Duncan Multiple Range Test.

Tongo (2014) showed that The different levels of SAP could absorb and hold water and consequently reduce the effect of drought stress and improve the growth characteristics and reduce the activity of catalase and peroxidase enzymes.

Effect of polymer and irrigation depth before flowering

Also, the results indicated that application of P10 with the both irrigation depthS (I1= 7.5 and I2=10 mm) resulted in highest value of flax length. The shortest height was obtained in application of P0 with the both I1 and I2. In fact the height of flax enhanced following content f polymer (Fig. 1). The highest number of branches in plant was seen in the I2P10 (n=9) and the lowest number was seen in I1P0 (n=6) (Figure 2). The results indicated that the highest content of dry matter was in application of I2P10 and I1P10 with 36.7 and 32.3 g, respectively. The lowest number was in I2P0 (17.6 g) (Figure 3).

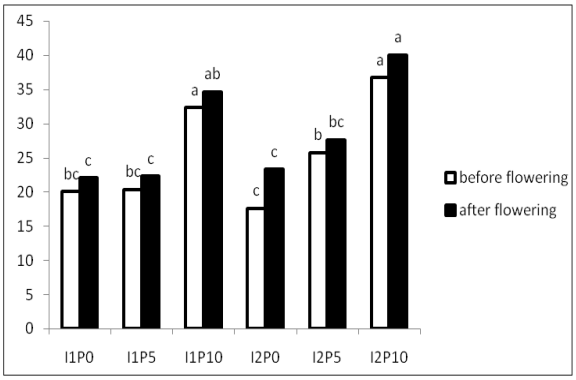

Fig. 1. Effect of different levels of polymer (P0=control, P5= 500 and P10= 1000 kg polymer per hectare) and irrigation depth (I1= 7.5 and I2= 10 mm) on dry matter of flax plant. There were four replicates for each treatment. The column with similar letter had no significant difference according Duncan Multiple Range Test ($P<0.05$).

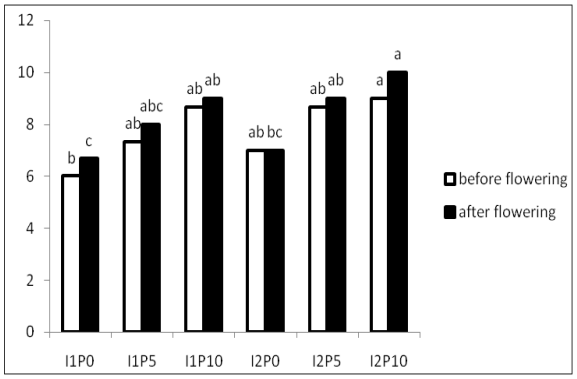

Fig. 2. Effect of different levels of polymer (P0=control, P5= 500 and P10= 1000 kg polymer per hectare) and irrigation depth (I1= 7.5 and I2= 10 mm) on number of shrubs in flax plant. There were four replicates for each treatment. The column with similar letter had no significant difference according Duncan Multiple Range Test (P<0.05).

Effect of polymer and irrigation depth after flowering

The results indicated that application of P10 with the both I1 and I2 resulted in highest value of flax length. The shortest height was obtained in application of P0 with the both I1 and I2 (47 and 47.33 cm). In fact the height of flax enhanced following content f polymer (Fig. 1). The highest number of branches in plant was seen in the I2P10 (n=9) and the lowest number was seen in I1P0 (n=6.6) (Fig. 2). The results indicated that the highest content of dry matter was in application of I2P10 and I1P10 with 40 and 34.6 g, respectively. The lowest number was in I1P0 (22 g) (Figure 3).

The overall results of this study indicated that dry matter of flax plant increased following polymer concentration. Similar results were obtained by Karimi and Naderi (2007) who found that application of polymers resulted in the absorption and retaining of the irrigated water that will be released little by little, so that the plant could access to moisture and so irrigation efficiency increased (Hutterman *et al.*, 1990). Similar results were obtained by Khalil Pour (2001) who found that polymer BT53 increased affinity percentage of plants in the soils which subjected to erosion risk through retention of *water in the soil and making cohesion and reducing soil surface erosion*. Barihi *et al* (2013)the results of investigations showed that the use of super absorbent polymer of ABA200 resulted in increased performance level, water use efficiency and some growth indices of greenhouse cucumber as well as storage of nitrogen in its fruit.

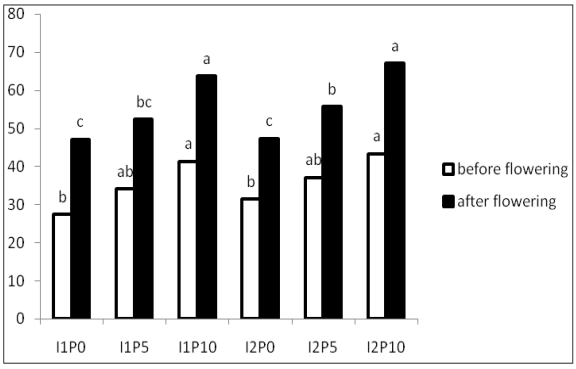

Fig. 3. Effect of different levels of polymer (P0=control, P5= 500 and P10= 1000 kg polymer per hectare) and irrigation depth (I1= 7.5 and I2= 10 mm) on height of flax plant. There were four replicates for each treatment. The column with similar letter had no significant differenceaccording Duncan Multiple Range Test (P<0.05).

The final results showed that application of different content of polymer PR33005A before and after flowering affect growth properties of flax plant. So it is could be recommended in flax cultivation system for increasing yield if its cost was justified.

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