



RESEARCH PAPER

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Effect of super absorbent gel (hydro gel) usage in the establishment and Survival of *Pistacia atlantica* Desf. seedlings

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Abstract

The present study includes the experiment of establishment and survival of *Pistacia atlantica* seedlings by using super absorbent gel (hydro gel). For this purpose 5 dosages super absorbent gel (0, 5, 10, 15 and 20 g), 4 irrigation intervals (no irrigation, 15 day, 30 day, 45 day intervals) and 3 liters of water equally for every seedlings were considered, in which super absorbent is the main plot and irrigation intervals were in subplots. The statistical design was completely random blocks with three replication and collected data were analyzed based on Discriminate Statistic method by software SAS 9/1, Minitab13 and SPSS 15. Results showed that superabsorbent gel is affective in survival and establishment of *Pistacia atlantica* seedlings by increasing irrigation intervals. Using 20 grams of super absorbent in all stages and 15 days interval irrigation has the maximum impacts on survival and establishment of seedlings. The interesting result was that more than 50% of planted seedlings can be saved by 20 g of super absorbent gel with only 45 days irrigation interval.

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Introduction

Forests are one of the major natural resources that support human being life and other living being on the earth. The survival of a natural forest depends on its regeneration. However, overexploitation of forests in Zagros region, located in western Iran, has resulted in extensive degradation and also reduction of the sexual (by seed) and asexual (vegetative) reproduction rates (Bazyar *et al.* 2012).

Plantation and forest rehabilitation projects in the Zagros forests have been unsuccessful due to insufficient water supplies and problems in water availability. So, it is crucial to look for alternative methods not only to decrease water consumption but also increase soil moisture and seedling maintenance over a growing season. A new technique is using super-absorbent.

The super-absorbent material has many applications and can increase the field capacity and water absorption. These properties are useful in drought stress (Chatzopoulos *et al.* 2000). Water-absorbing polymers have Ability to attract water 4000 times than their weight (Raju *et al.* 2002).

Iran with 250mm rainfall is considered as dry and low-water area on the earth. Continental changes, rain fall and moisture decreasing cause more destruction of nature and lack of establishment of forest seedlings so as natural Zagros forest is going to become a ruined place. Severe decreasing of natural procreation (growth) in Zagros forest causes to shooting of acorn forest and aging of tree species such as *Pistacia atlantica* which provides the risk of their decadence. *Pistacia atlantica* is one of the most important plant species in Zagros forests and considering of improper age composition of natural abnormal mass of *Pistacia*, a suitable way should be found to revive of this forests.

Soil permeability reduction, unbalanced distribution of rainfall and water maintenance power reduction in the soil are most important environmental factors in lack of establishment of new seedlings, especially

Pistacia atlantica. The super absorbent gel usage (hydro gel) can be effective as a new way for increasing of rainfall and irrigation effectiveness in the establishment of *Pistacia atlantica* seedlings which itself is useful for forest revival. In 1974, researchers at the USDA Northern Research Lab, in Peoria, Illinois, developed a starch superabsorbent that was high swell and significantly reduced the amount of material needed to absorb a given quantity of water. Industrial Services International, Inc. (ISI) was formed, and licensed by USDA to promote the use of these new materials.

Banj Shafiei *et al.* (2012) studied the effect of 3 levels (0,5 and 100 g) of super absorbent, 2 levels of irrigation (5 &10 L) and irrigation interval (10 , 20 & 30 days) on the growth of *Pistacia atlantica* in Javanshir's farms and announced the results. By using 50 g of super absorbent amount of irrigation at intervals of 10 days reduced to one-half (5 ml), 100 g super absorbent and 10 liters of water, Double the time between double irrigation turn (20 days) and dropped 50% of water consumption. Also, the use of super absorbent increases the height and the diameter growth of seedlings respect to indicator. Jalili *et al* (2010a) studied the effect of four irrigation intervals (6, 10, 14 and 18 days) and four levels of super absorbent polymer (0, 40, 90 and 140 g) on the growth in Rose seedling and finally announced super absorbent has a significant effect in the increase of irrigation intervals and plant growth parameters in Rose seedling. They studied the Effect of Super Absorbent Polymer (Tarawat A200) and Irrigation Interval on Growth of Almond Sapling (*Amygdalus communis*) too, and concluded that all irrigation intervals using super absorbent at the end of first growth season did not have any significant effect but in the middle of growth season (July) in some of growth parameters such as branch height and average canopy cover diameter had significant effect was observed (Jalili *et al.* 2010b).

Yield and morphological characteristics of *Brassica campestris* by Zeolite treatments was studied and results showed the significant difference ($p < 0.01$)

between different levels of Zeolite (Baghban Mali *et al.* 2012).

Fangchum *et al.* (2012) studied the effect of super absorbent on dry matter accumulation and nutrient uptake of *Pinus spinaster* seedling and concluded that The shoot and root of this species with super absorbent had higher yields with fertilizer addition and increased the N and K contents but the P content did not differ significantly.

The aim of this research is study effect of super absorbent gel (hydro gel) usage in the establishment and Survival of *Pistacia atlantica* Desf. Seedlings in the Pavah forest, Kermanshah province in middle Zagros forest

Materials and methods

Study area

This project has been done in Desheh-Village as one of subareas of Pavah city in Kermanshah province with following characteristics:

Geographical coordinate: 35° 04' 30" N and 46° 16' 05" E, Altitude: 1450 meters above sea level, slope: 25 %- 30%, understory coverage: 95 % and Canopy: 40% - 80%. Forest form is coppice with a few seedlings. The dominant forest type is *Quercus brantii*- *Pistacia atlantica*, with wild cherry (*Prunus* sp.) and *Cratagus* sp. as co dominant species.

Methods

In this research after field studies and finding the experiment site, and Bibliography for super absorbent

dosage, two years old Pot seedlings were planted in 7/5/2003. *Pistacia atlantica* seedlings must be planted in the shadows of trees and stones (Zangeneh, 1998). The seedlings had been planted within 30 cm. distances and block distance considered 3-5 m. The statistical design for this research was the completely random blocks and Survival of seedlings was measured in four stages (13/7/2003, 4/10/2003, 17/11/2003 and 4/4/2004). The experimental design was split plot and the main factor of super absorbent was in 5 levels [(a1) without using super absorbent as indicator,(a2) 5 g, (a3) 10 g,(a4) 15 g and (a5) 20 g]. Sub factor B including irrigation period: [(b1) without irrigation as indicator, (b2) 15 days, (b3) 30 days, and (b4) 45 days interval irrigation]. The amount of water for all treatments in every irrigation interval was fixed at 3 liter. data was collected during the first growing season, next year in July, October, November and April, then survival of seedlings was analyzed by the statistical software; SAS 9/1, Minitab13 and SPSS15.

Results and discussions

The collected data was analyzed and the obtained results are shown in 1 to 3 Tables and figures.

The main factor of the Superabsorbent

The best sample of the main factor in all stages of data collecting is related to the 5th level (a5) A Factor, i.e. 20 g of super-absorbent gel (43/75 %) and the worst attendance is related to 1st level (a1) A Factor, i.e. zero g of super-absorbent gel (31/25 %) survival (Table1, Figure 1).

Table 1. Survival percent of *Pistacia atlantica* seedlings in different levels of main factor A.

Date	13/07/2003		4/10/2003		17/11/2003		04/04/2004		
	Survival	N	%	N	%	N	%	N	%
Factor									
a1	31		64/8	19	39/58	19	39/58	15	31/25
a2	33		68/75	23	47/92	21	43/75	16	33/33
a3	35		73	25	52/08	23	47/92	19	39/58
a4	35		73	26	54/16	26	54/16	19	39/58
a5	37		77/1	28	58/33	27	56/25	21	43/75

Various sub factor of irrigation periods

The best survival in sub factor is related to 2nd level (b2) B Factor, i.e. 15 day intervals (31/25 %) and the

worst attendance is related to 1st level (b1) B Factor, i.e.no irrigation (27.08 %) survival (Table 2, Figure 2).

Table 2. Survival of *Pistacia atlantica* seedlings in different levels of sub factor B.

Date	13/07/2003		4/10/2003		17/11/2003		04/04/2004	
Survival	N	%	N	%	N	%	N	%
Factor								
b1	31	64/8	21	43/75	21	43/75	13	27/08
b2	44	91/67	41	85/42	41	85/42	36	75
b3	37	77/08	31	64/58	29	60/42	21	43/75
b4	38	79/17	27	56/25	25	52/08	20	41/67

Table 3. Survival of *Pistacia atlantica* seedlings in different levels of main and sub factors A and B.

Date	13/07/2003		4/10/2003		17/11/2003		04/04/2004	
Survival	N	%	N	%	N	%	N	%
Factor								
a1b1	5	41/67	4	33/33	4	33/33	2	16/67
a1b2	11	91/66	10	83/3	9	75	7	58/33
a1b3	9	75	7	75	6	50	4	33/33
a1b4	10	83/3	4	33/33	4	33/33	3	25
a2b1	6	50	4	33/33	4	33/33	2	16/67
a2b2	9	75	8	66/67	8	66/67	6	50
a2b3	6	50	4	33/33	3	25	1	8/33
a2b4	10	83/3	7	75	6	50	6	50
a3b1	6	50	5	41/67	5	41/67	3	25
a3b2	12	100	9	75	9	75	8	66/67
a3b3	6	50	7	58/33	7	58/33	5	41/67
a3b4	11	91/66	7	58/33	6	50	3	25
a4b1	9	75	4	33/33	4	33/33	4	33/33
a4b2	12	100	7	58/33	7	58/33	7	58/33
a4b3	8	66/67	6	50	6	50	6	50
a4b4	8	66/67	2	16/67	2	16/67	2	16/67
a5b1	5	41/67	4	33/33	4	33/33	2	16/67
a5b2	9	75	8	66/67	8	66/67	8	66/67
a5b3	8	66/67	9	75	7	58/33	5	41/67
a5b4	11	91/66	9	75	7	58/33	6	50

Interaction between main factors (levels of super absorbent), with sub-factors (irrigation periods)

In combination of 2 factors, a5b2 factor, i.e. 10 g of super-absorbent gel by once irrigation in 15 days with 33/58 % survival, a5b4 factor, i.e.20 g of super-absorbent gel by once irrigation in 45 days with 50 % survival were the best attendance by most survivals and a2b3 factor, i.e.5 g of super-absorbent gel by once irrigation in 30 days with 8/30 % survival had the least survival (Table and Figure 3).

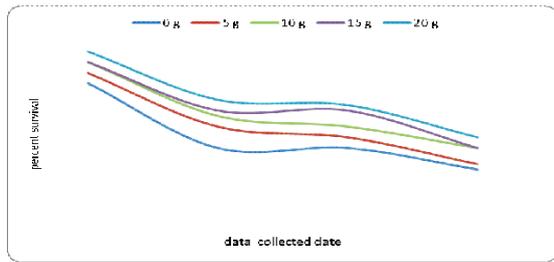


fig. 1. Survival diagram of *Pistacia atlantica* seedlings in different levels of main factor A.

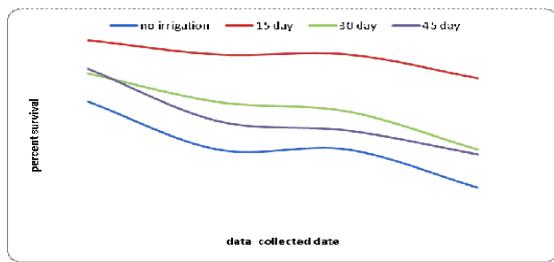


fig. 2. Survival diagram of *Pistacia atlantica* seedlings in different levels of sub factor B.

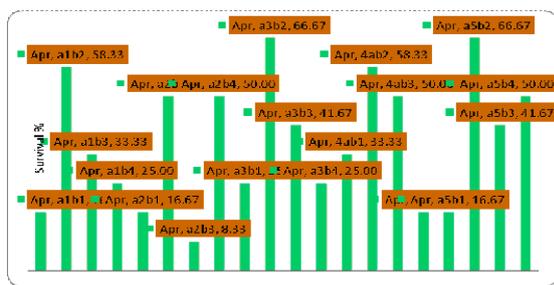


fig. 3. Survival diagram of *Pistacia atlantica* seedlings in composition of main and sub factors A and B.

Conclusion

Knowing the Superabsorbent dosage is a good guide and can solve many problems in managing forest lands, such as reforestation and rehabilitation of damaged areas. Although there isn't much

information about Superabsorbent affect on the plant survival, but there are several studies that confirm decreasing irrigation required by using superabsorbent gel on *Pistacia atlantica* (Banj Shafiei *et al*, 2012), Rosa (Jalili *et al*, 2010a), Almond (Jalili *et al*, 2010b), *Brassica compestris* (Baghban Meli *et al*, 2012), Chickpea (Jahandide *et al*, 2012), and Cotton (Ahmadi *et al*, 2012) and etc.

Results of this survey divided to three sections interpretation of main factor of the Superabsorbent dosage

Our results revealed that different levels of super absorbent had significant effect on the planted saplings survival and according to the last data collecting the most survival was related to using 20 grams of super absorbent with 43 /75 % survival and the lowest survival was related to indicator (No use of super absorbent) with 25/31 % survival. In 2nd group namely 15 and 10 grams of super absorbent with 58/39%and 5 grams of super absorbent 33/33 are located in latter ranks (Figure 1). Results showed that with the consumption of 20gram super absorbent increased 40 %, taking 10 and 15 grams of super absorbent increases the 66/26 % and 5 grams of super absorbent increases 67/6 % establishment of *Pistacia atlantica* seedlings. Review of the main factor in this study showed that whereas the consumption of 20 grams of super absorbent in all stages has the maximum survival and establishment and the best attendance of *Pistacia atlantica* seedlings. As a consequence consumption of any amount of superabsorbent even 5 grams can improve conditions of survival and establishment of seedlings.

Interpretation of sub factor of various irrigation periods

Different irrigation interval has significant effect on survival of the planted saplings and the most survival in last data collecting is related to the once irrigation within 15 days (75 % survival), then the once irrigation in 30 days (43/75 % survival) and the once irrigation in 45 days (41/67 % survival). The lowest survival is 08/27 which is related to the non-irrigation (Table and Figure 2). As sub factor results,

15 days irrigation interval increased 176.69 %, 30 days irrigation interval increases 661.56 % and 45 days irrigation interval increase 53.88 % of Survival and establishment of seedlings. Totally this experiment showed that the once irrigation in 15 days has highest survival and establishment of *Pistacia atlantica* and best attendance in all stages.

Interpretation of interaction between main factors (dosage of super absorbent) and sub-factors (irrigation periods)

interaction between main factors (super absorbent dosage) and sub-factors (irrigation periods) has significant effect on survival of the planted saplings and the most survival is related to the 20 grams of super absorbent for the once irrigation in 15 days (66.68 % survival), then 10 grams of super absorbent and 15 days interval irrigation (66.68 % survival), 15 grams of super absorbent and 15 days irrigation interval (58.33 % survival), 20 grams of super absorbent and 45 days irrigation interval (50 % survival), and the lowest one (16 % survival) is related to no-super absorbent and no irrigation (table and figure 3). On the whole irrigation periods and quantity of super-absorbent are effective in survival and establishment of *Pistacia atlantica* seedlings, although their interaction was not significant (due to lack of proper selection of super absorbent surfaces), but the combination of their attendance can be effective in the establishment and survival. Results showed that the use of 20 g of super absorbent gel only with 45 days irrigation interval can save more than 50 % of planted seedlings and given to the area climate condition, with two or three times irrigation, the intense dry season can be passed.

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