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# The effect of different levels of irrigation with superabsorbent (S.A.P) treatment on growth and development of Myrobalan (*Prunus cerasifera*) seedling

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**This study was conducted with the main purpose to investigate the effect of super absorbent polymer and different levels of irrigation on characteristics of Myrobalan (*Prunus cerasifera*) seedling. The experiment was laid out in randomized complete design with five level (0.0, 0.5, 1, 2 and 3%) super absorbent polymer and three levels of water irrigation including 4 day (control), 8 and 12 day from germination until two month and each of these levels was repeated ten replication at Khorasan Razavi Natural Resources and Agricultural Research Center. During the experiment, the plants different physicomorpholigic such as plant height, number and surface of the leaf, fresh and dry weight of plant, number of root, root height and diameter of plant were estimated. The results indicated that the effect of interaction between super absorbent and water stress was significant on some of quantity characteristics of *P. cerasifera.* In all traits, a significant decrease was observed with increase in stress level. The highest plant height, number and surface area of the leaf, fresh and dry weight and diameter of plant was related to irrigation after 4 days with 3% polymer application and the lowest was related to irrigation after 12 days with no application of polymer. The results indicated that using S.A.P controlled of relationship soil, water and plant, decrease water stress.**

**Key words:** Level irrigation, *Prunus cerasifera*, superabsorbent polymer, water stress.

## INTRODUCTION

Water shortage is usually one of the important reasons for the reduction of performance in the unit area of arid and semi arid areas (Shamim et al., 2009). Iran has arid and semi arid climate, so the drought stress is considered as one of the main problems of production in this country. Since 75% of our country's regions have a rainfall of less than 250 mm in year, the danger of drought is considered serious. Low water potential caused by a soil water deficit is one of the major natural limitations of the productivity of natural and agricultural ecosystems, resulting in large economic losses in many regions (Wu and Cosgrove, 2000). In order to save soil moisture, some materials such as crop residue, mulch plants, waste, litter, straw and stubble, and other synthetic materials like Hydroplus. 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. Super absorbents, depending on their source and structure, are divided in two main groups of natural and synthesis. They are applied in gardens, landscapes and agriculture to protect and store humidity in soils and release water slowly through soil

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(Orzeszyna et al., 2006). Super absorbent polymers by increasing the capacity of water storage in soil (Sarvas et al., 2007), reduction of wasting water and nutrition materials of soil, reduction of water evaporation from the surface of soil (Sarvas et al., 2007) and increasing the aeration of soil causes the better growth and enlargement of plants and as a result, increase the yield under normal irrigation and water stress condition. These materials decrease the number of irrigation times by increasing the gaps of irrigation, therefore water cost and energy will be saved (Sivapalan, 2001). The half life is in general in the range 5 to 7 years, and they degrade into ammonium, carbon dioxide and water. Increasing in seedling survival and growth was reported with several plant species (Abedi-koupai and Asadkazemi, 2006). Yazdani et al. (2008) reported that the high rates of superabsorbent polymer (225 kgha$^{-1}$) had positive effects on yield and yield components of soybean even under drought-stress conditions. Islam et al. (2011) indicated that the greatest effect of polymer addition on the biomass of oat (*Avena* spp.) was related to 60 kgha$^{-1}$.

Prunus varieties is one of the most important genera of woody plants in Iran. The most important rootstock species is Myrobalan for plums. This experiment was carried out with the aim of investigating the effect of super absorbent polymer A200 and different levels of irrigation on characteristics of Myrobalan (*Prunus cerasifera*) seedling.

## MATERIALS AND METHODS

The experiment was conducted at Khorasan Razavi Natural Resources and Agricultural Research Center, Iran. A completely randomized design with 10 replicates for each treatment was used in this experiment. The primary factor included three irrigation regimes including irrigation at 4, 8, 12 days and secondary factor included five amounts of super absorbent polymer A200 (Rahab Rezin Company, Institute of Polymer Research, Karaj, Iran) including 0.0, 0.5, 1, 2 and 3% polymer per pot.

Myrobalan *(P. cerasifera*) seeds were removed from cold storage (4°C) and planted in containers. After treatment, each pot was irrigated with 300 cc of water per application. By the end of this period, the watering was discontinued and survival and growth variables of the seedlings were determined. Plant growth indices were measured to determine the effects of irrigation frequency and hydrogel amendment rates on seedling development. Stem diameter 1 cm above the medium and plant height were measured on last days of the experiment. The number of the leaves per plant was measured. At the end of the experiment, leaves were removed from the plants, and leaf area was determined with a portable area meter (Model LI-3OO0, Li-Cor, Inc., Lincoln, NE). Leaves and stems were dried in an oven at 70°C for 3 days; their weights were combined for shoot dry weight. Roots were washed free of growth medium and hydrated polymer and then oven dried as previously described before determining dry weight.

## RESULTS AND DISCUSSION

Plant height was significantly affected by irrigation frequency. Increasing irrigation interval has resulted in the decrease of plant height, so the highest (24 cm) and the lowest (6.3 cm) values were observed in 4 day irrigation interval and 3% polymer and 12 days irrigation interval and no hydrogel, respectively (Figure 1). Drought stress led to the reduction in stem diameter, water potential to a lower level needed for cell elongation and, consequently, shorter internodes and stem height. The decrease in shoot length as response to drought may be either due to the decrease of cell elongation resulting from water shortage, which led to a decrease in each cell turgor, cell volume and, eventually, cell growth or due to blocking up of xylem and phloem vessels, thus hindering any translocation through (Lovisolo and Schuber, 1998).

Highly significant ($p < 0.01$) differences were observed among water deficit treatments with respect to number of root (Figure 2) and root length (Table 1). While increasing the irrigation interval, number of root and root length was significantly reduced. Our results showed that the effects of super absorbent polymer and irrigation regime ($p < 0.01$) and their interactions were significant ($p < 0.05$) for stem diameter. The highest effect of polymer addition on the stem diameter is related to 3%. The highest (2.4 cm) and the lowest (1.6 cm) values are related to 4 day irrigation interval and 3% polymer and 12 day irrigation interval and no hydrogel respectively (Table 1)

Nezami et al. (2008) reported that the decrease of soil water content to 60 and 30% field capacity (FC) caused a 20 and 46% reduction in stem diameter, as compared to the control, respectively. Abedi-koupai and Asadkazemi (2006) indicated that the greatest effect of polymer addition on the shoot diameter of ornamental plant (*Cupressus arizonica*) was related to 6 gkg$^{-1}$.

Dry and fresh weights increased significantly ($p < 0.01$) with more frequent watering. Irrigating at forth day resulted in greater dry and fresh weights compared to watering once every 8 days which was greater than watering once every 12 days. Although we found that plants grew larger with more frequent irrigation, a previous study (Ingram and Yeager, 1987) reported that plant height as well as shoot and root dry weights were higher with more frequent watering. Drought stress had negative effect on current photosynthesis and remobilization. In addition, a reduction of weight may occur due to a lower photosynthate production, because of excessive loss of leaves (Rauf, 2008). High weight, resulting from more irrigation, was probably due to the availability of adequate soil moisture Application of polymer tended to increase weight of seedling compared to the control (without polymer) ( Table 1).

Data on number of leaf and leaf area showed that irrigation frequency had a significant effect on this parameters. Number of leaf and leaf area decreased by increasing the drought stress. Daneshmandi and Azizi (2009), declared that the number of leaf and leaf area was significantly reduced as water stress increased. Irrigation after 4 days and 3% polymer gave significantly large number of leaf and leaf area (16.5 and 169.5 cm$^2$) against the lowest one (9 and 17 cm$^2$), recorded under

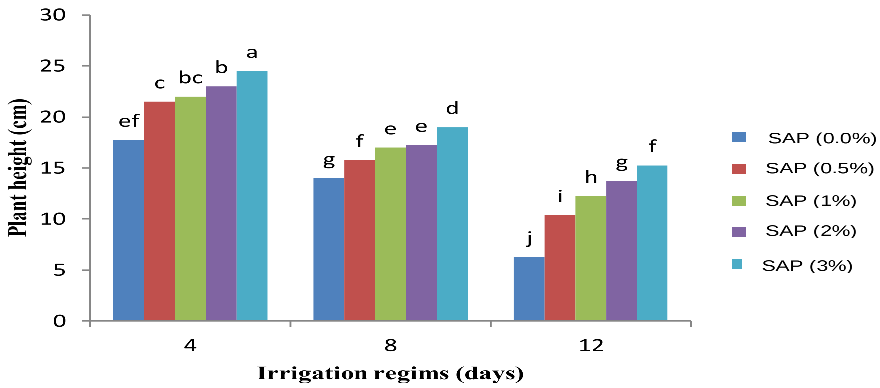


**Figure 1.** Effect of Super absorbent polymer and irrigation regimes on height of Myrobalan seedlings.

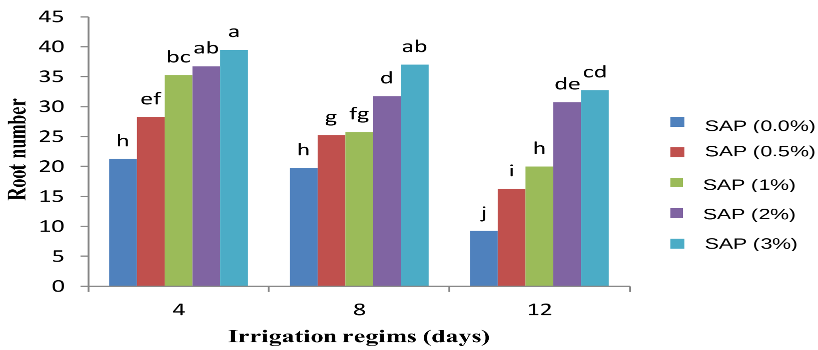


**Figure 2.** Effect of Super absorbent polymer and irrigation regimes on root number of Myrobalan seedlings.

**Table 1.** Effect of super absorbent polymer and irrigation level on agronomical traits Myrobalan seedlings.

| Treatment | Irrigation regims (days) | Leaf area ($cm^2$) | Stem diameter (mm) | Dry weight (g) | Number of leaf | Fresh weight (g) | Root length (cm) |
|---|---|---|---|---|---|---|---|
| | 4 | $13^{cd}$ | $1.983c^{d}$ | $0.728^{defg}$ | $63^{i}$ | $2.805^{ef}$ | $19.00^{e}$ |
| SAP (0 .0%) | 8 | $11.25^{ef}$ | $1.805^{f}$ | $0.622^{gh}$ | $40.75^{l}$ | $2.470^{gh}$ | $17.50^{e}$ |
| | 12 | $9^{g}$ | $1.637^{g}$ | $0.313^{j}$ | $17^{m}$ | $0.645^{k}$ | $10.25^{g}$ |
| | 4 | $13.75^{c}$ | $1.993^{cd}$ | $0.805^{cde}$ | $84^{f}$ | $3.270^{d}$ | $25.25^{b}$ |
| SAP (0.5%) | 8 | $12d^{e}$ | $1.815^{f}$ | $0.708^{efg}$ | $48^{k}$ | $2.880^{e}$ | $22.75^{c}$ |
| | 12 | $10.75^{f}$ | $1.805^{f}$ | $0.425^{i}$ | $47^{k}$ | $1.165^{j}$ | $15.25^{f}$ |
| | 4 | $14^{c}$ | $2.12^{b}$ | $0.907^{bc}$ | $110^{c}$ | $3.515^{cd}$ | $27.75^{a}$ |
| SAP (1%) | 8 | $12^{de}$ | $2^{cd}$ | $0.758^{def}$ | $80^{g}$ | $2.960^{e}$ | $25.00^{b}$ |
| | 12 | $11^{ef}$ | $1.865^{ef}$ | $0.467^{i}$ | $54^{j}$ | $1.169^{i}$ | $15.50^{f}$ |
| | 4 | $15.25^{b}$ | $2.173^{b}$ | $1.002^{b}$ | $122.25^{b}$ | $3.820^{b}$ | $28.00^{a}$ |
| SAP (2%) | 8 | $12^{ed}$ | $2.012^{c}$ | $0.823^{cd}$ | $82.25^{fg}$ | $3.408^{cd}$ | $27.00^{a}$ |
| | 12 | $10.75^{f}$ | $1.897^{def}$ | $0.528^{hi}$ | $67^{h}$ | $2.230^{h}$ | $21.00^{d}$ |
| | 4 | $16.5^{a}$ | $2.45^{a}$ | $1.277^{a}$ | $169.5^{a}$ | $4.480^{a}$ | $28.00^{a}$ |
| SAP (3%) | 8 | $14.25^{ab}$ | $2.175^{b}$ | $0.955^{b}$ | $105.25^{d}$ | $3.692^{bc}$ | $27.50^{a}$ |
| | 12 | $11.5^{ef}$ | $1.953^{cde}$ | $0.675^{fg}$ | $91.5^{e}$ | $2.578^{fg}$ | $18.75^{cd}$ |

irrigation after 12 days and no application of polymer (Table.1). The results indicated that the effect of different amounts of polymer and different rates of consumed water had a significant ($p < 0.01$) effect on number of leaf and their interactions were significant ($p < 0.05$) for number of leaf.

Finally, regarding the limitation of water resources, super absorbent polymer could be a useful strategy for yield sustainability under drought stress in Myrobalan seedling.

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