
OSMOCONDITIONING *PINUS BRUTIA* VAR. *ELDARICA* SEED FOR FASTER GERMINATION

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ABSTRACT

Rapid and complete germination is essential for the efficient production of *Pinus brutia* var. *eldarica*. Osmoconditioning has proved successful for the improvement of speedy germination of the most plant species. The objective of this study was to evaluate the effect of osmoconditioning on *Eldarica* pine seed. Total germination and germination speed of *Eldarica* pine were assessed by seed treatment with different polyethylene glycol (PEG) 8000 concentration and duration in 2 different experiments. In experiment 1, seeds were conditioned in aerated solution of PEG for 0, 2, 5, 7, 9, and 11 days with three PEG concentration having water potential of -0.5, -1.1, and -1.8 MPa. In experiment 2 seeds were treated with PEG for 1, 4, 8, and 16 days having water potential of 0, -0.5, -1.8, and -4.1 MPa. After osmoconditioning seeds were grown in incubator in germination boxes on Whatman No.1 filter paper. None of the PEG concentration or duration improved total germination. However, seed treatment up to 9 days significantly reduced days to 50 percent germination. Osmoconditioning longer than 9 days was deleterious.

Keywords: PEG 8000, Concentration, osmoconditioning duration, *Eldarica* pine.

INTRODUCTION

Osmoconditioning allows the seed to absorb

limited amount of moisture and starts pregerminative activities, but this moisture is not enough for radicle to protrude from seed coat and the seed remains under partial moisture stress (Bradford 1986, Heydecker and Coolbear, 1977). Osmoconditioning promotes faster and more uniform seedling germination for most plant species (Murray, 1990; Hallgren, 1987 and 1990, Bray *et al.* 1989, Taylor 1988, Simak *et al.* 1984, Brocklehurst and Dearman 1983a-1983b, Szafiroska *et al.*, 1981 and Heydecker and Wainwright 1976). However the effect of osmoconditioning on total germination is species dependent. Carpenter (1989), Hallgren (1987), Simak *et al.* (1984), and Brocklehurst and Dearman (1983a-1983b) observed improved total germination, while Murray (1990) and Hallgren (1990) noted decreased germination of primed seed. Osmoconditioning is mostly done on vegetables with little work on conifers. The objectives of these experiments were to evaluate the effect of osmoconditioning on speed and total germination of *Eldarica* pine.

MATERIALS AND METHODS

Experiment 1

Eldarica pine seeds were osmoconditioned in aerated PEG 8000 solution at -0.5, -1.1, and -1.8 MPa for 0, 2, 5, 7, 9, and 11 days. Seeds were aerated using an aquarium pump. The water loss of the solution was maintained at a constant level

by adding water daily. After priming, the seeds were rinsed in tap water for about 2 minutes. Seeds were soaked in distilled water for 8 hours in controlled treatment. Primed and unprimed (8 hours distilled water soaked) seeds were sown at New Mexico State University, USA on November 20, 1989 in incubator set at 21°C. The seeds were germinated in germination boxes measuring 13 x 13.5 cm on Whatman No.1 filter paper wetted with distilled water. The experiment was laid out in Randomized Complete Block design as 3 x 6 factorial, with data analyzed by analysis of variance and upon obtaining significant F-values, Least Significant Difference (LSD) Test was employed to compare means.

Twenty seeds per box were used, replicated three times. Germination counts were made daily until the 23rd day, thereafter no germination occurred. Germination was defined as seeds with visible radicle protrusion through the testa. Days to 50 percent emergence (T50) were counted from sowing till 50 percent of the seedlings germinated in each treatment. All germinants for each treatment were summed to record total germination data.

Experiment 2

Seeds were osmoconditioned at 0, -0.5, -1.8, and -4.0 MPa for 1, 4, 8, and 16 days. The primed and unprimed (24 hours water soaked) seeds were germinated in incubator on Whatman paper No. 1 in the similar way as used in experiment 1. Seeds were sown on March 22, 1990. Total germination and germination speed counts were made as described for experiment 1. The design used was Randomized Complete Block with 4 x 4 factorial replicated thrice.

RESULTS

Experiment 1

Germination (percent)

PEG concentration (C), seed treatment duration (T) and the interaction between CxT significantly affected germination (Table 1). Maximum germination (93.3%) was observed in seeds soaked in distilled water for 8 hours (Fig. 1). Germination gradually decreased with increase in duration, with maximum reduction to 46.7% with 11 day duration. PEG concentration of 200 and 300 g PEG/kg water resulted in higher germination while 400 g PEG treated seed resulted in lowest germination (Fig. 2).

Days to 50 percent Germination:

Concentration, duration, and C x T interaction significantly affected days to 50 percent germination (T50) [Table 1]. T50 was enhanced with each increment of seed treatment duration up to 9 days (Fig.3). T50 was reduced by 0.8, 0.7, 0.5 and 0.5 day per day exposing seed for 2, 5, 7 and 9 days duration, respectively. The eleven day duration delayed germination even more than control and delayed T50 to 12.3 days. Lower concentration (200 and 300 g PEG) enhanced days to T50 while 400 g PEG slower the speed of germination (Fig.4).

Experiment 2

Higher concentrations of PEG and longer seed treatment durations than experiment 1 were used to see their effect on germination.

Germination (percent)

Concentration (C) and duration (T) significantly affected germination (Table 1). Increases in the

seed treatment duration significantly reduced the germination (Fig. 5). Poor germination was recorded for 16 days seed treatment duration. Seed soaked in water for 24 hours resulted in maximum germination (Fig. 6).

Germination decreased with increase in PEG concentration and lowest germination was noted when seed soaked in aerated solution of 600 g PEG.

Days to 50 percent Germination

Concentration (C), duration (T) and $C \times T$ interaction significantly affected days to T50 germination (Table 1). T50 decreased with each increment of seed treatment duration and fewer days to T50 germination were observed when seed treated for 8 days (Fig. 7). The reduction in T50 was 0.4 and 0.1 per day for 4 and 8 days duration respectively. Further increase in duration delayed days to T50. Seed soaked in water took fewer days to T50 than PEG-treated seed (Fig. 8). High concentration (600 g PEG) delayed germination. Concentration of 200 g PEG for 8 days was the best.

DISCUSSION

Lower concentrations (C) comparatively resulted in more emergence than higher concentration. Neither concentration nor seed treatment duration improved total germination compared to seed soaked in distilled water. Similar results were reported by Hallgren (1990, 1987) working with short leaf and slash pine. However, it differs from Simak et al. (1984) who observed increased germination of scot pine.

Seed soaked in distilled water improved germination. Improved germination of lettuce was also reported by Cantliffe et al. (1984), Guedes et al. (1981), and Wurr and Fellows (1984). They

further added that soaked seed performed better than control even at higher temperature. Drastic reduction in germination after 9 days duration was probably due to high infestation with pathogens because the conditions were conducive for fungal growth. PEG enhanced days to T50 percent germination. Lower PEG concentration took fewer days to T50 compared with higher concentrations. Seed treatment duration enhanced days to T50 compared with seed soaked in water. PEG enhanced T50 up to 9 days seed treatment duration. Bodsworth and Bewley (1981), Murray (1990), Lopes and Takaki (1988), Carpenter (1989), Heydecker and Wainwright (1976), and Dearman et al. (1986) also reported enhanced germination of PEG treated seed. Faster T50 is species dependent and may not be true for all species. Carpenter (1990) and Bussell and Gray (1976) observed no enhancement in days to T50 when seed of dusty miller and tomato were treated with PEG for different duration. Osmoconditioning of eldarica pine seeds with PEG 8000 solution can lead to rapid and synchronous germination. The osmoconditioning has obvious potential in improving the performance of seed with slow and highly variable germination.

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Table 1. Analysis of variance table of germination (%) and days to 50% (T50) germination of eldarica pine as affected by PEG 8000 concentration and seed treatment duration. Values in parenthesis are P values for mean squares values above it.

Source	D.F.	Mean Squares			
		Exp. 1		Exp. 2	
		Germ. (%)	Germ. speed (T50)	Germ. (%)	Germ. speed (T50)
Rep (R)	2	6.46	2.48	72.43	0.81
Con (C)	2/3*	25.68 (.003)	23.09 (.000)	282.47 (.021)	26.43 (.000)
Dur (T)	5/3*	93.54 (.000)	66.53 (.000)	1294.97 (.000)	7.40 (.024)
CxT	10/9*	8.28 (.045)	5.62 (.003)	106.54 (.226)	4.65 (.045)
Error	34/30*	.11	1.55	75.33	2.04

* D.F. for exp.2.

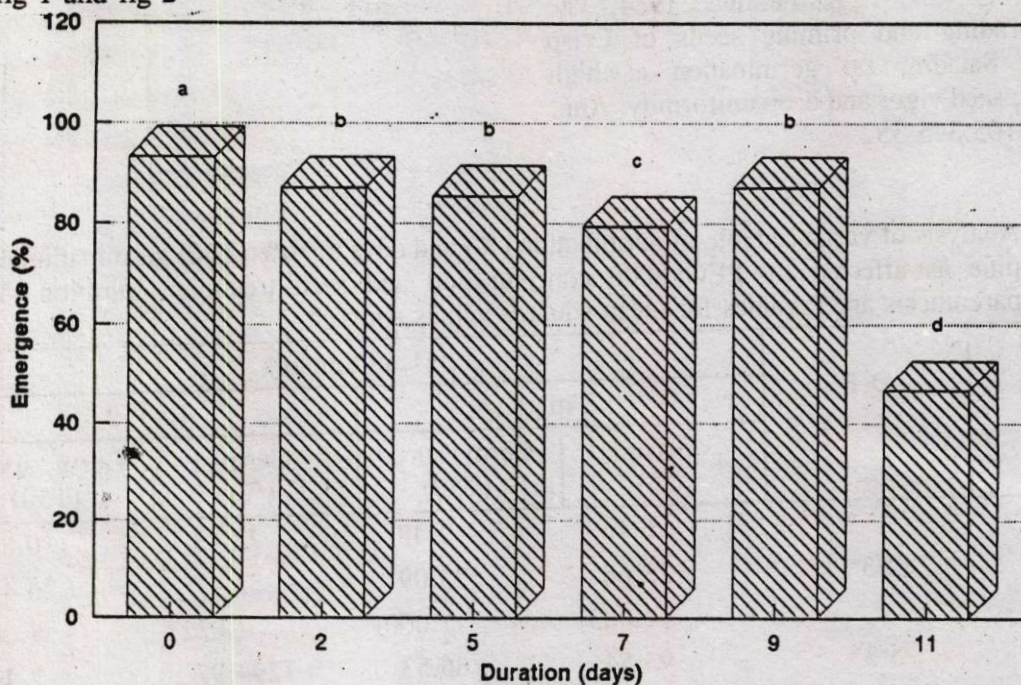


Fig. 1. Radicle emergence of eldarica pine as affected by duration. Bars with different letters are significantly different at $p=0.05$ using LSD.

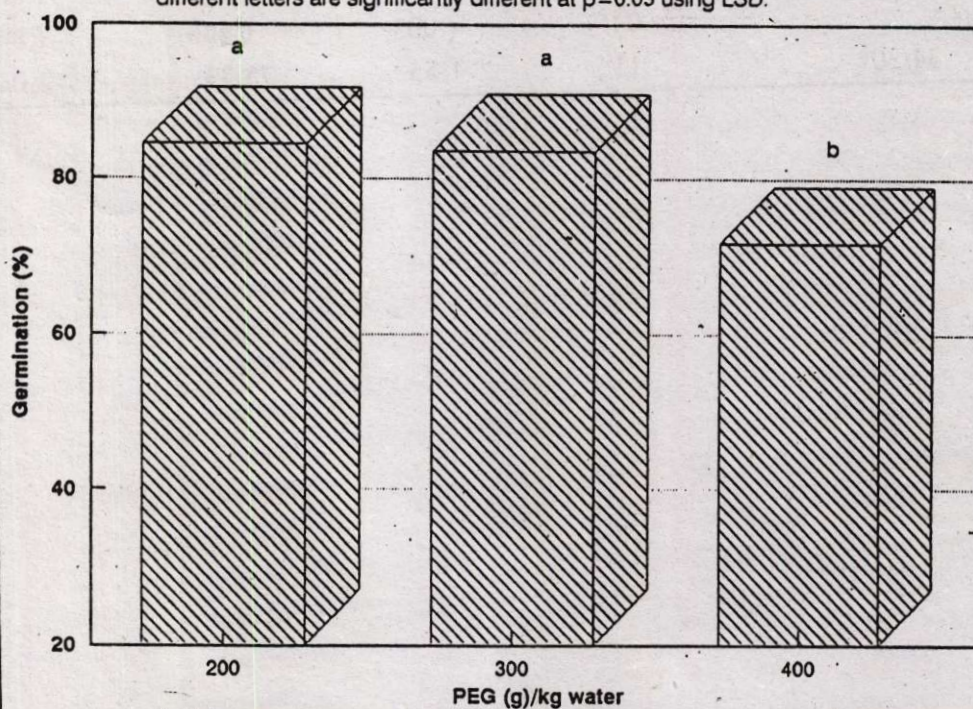


Fig. 2. Radicle emergence of eldarica pine as affected by PEG 8000 concentration. Bars with different letters are significantly different at $p=0.05$ using LSD.

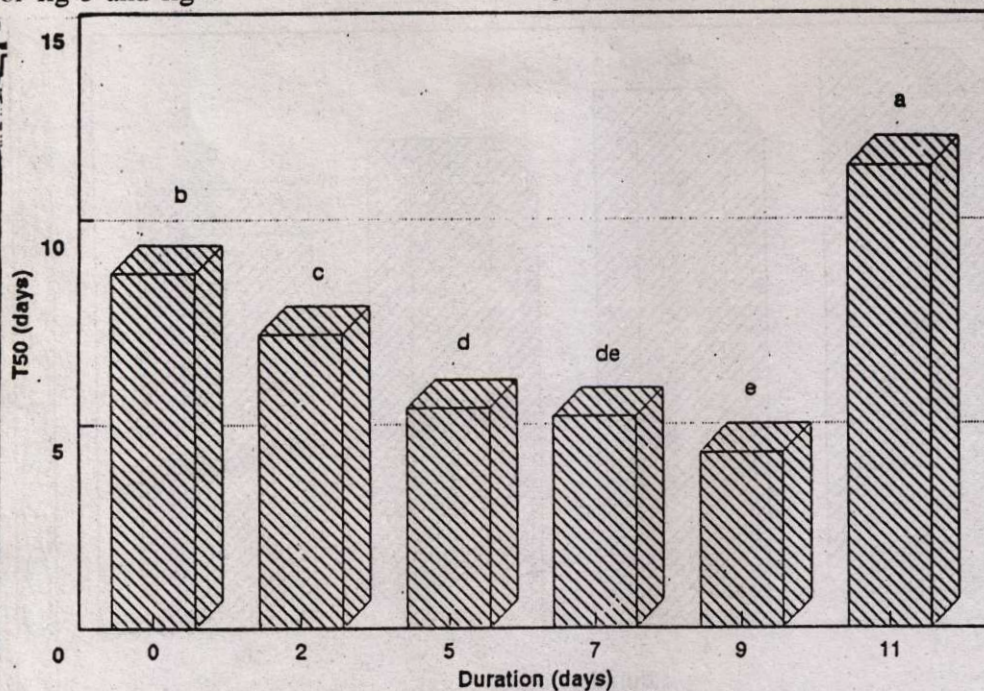


Fig. 3. Days to 50% radicle emergence of eldarica pine as affected by seed

treatment duration. Bars with different letters are significantly different at $p = 0.05$ using LSD.

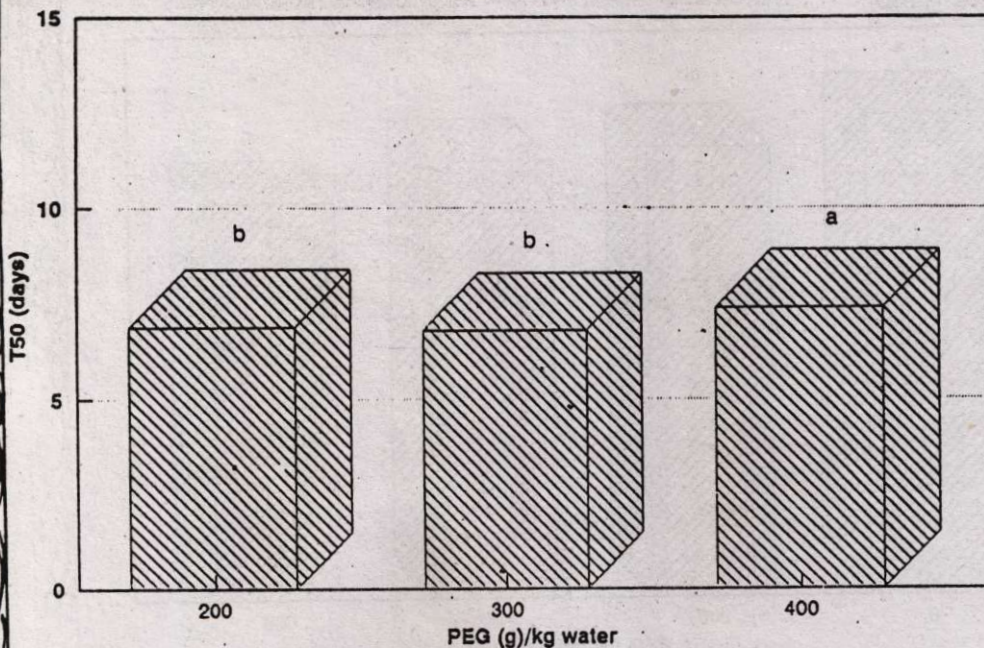


Fig. 4. Days to 50% radicle emergence of eldarica pine as affected by PEG 8000

concentration. Bars with different letters are significantly different at $p = 0.05$ using LSD.

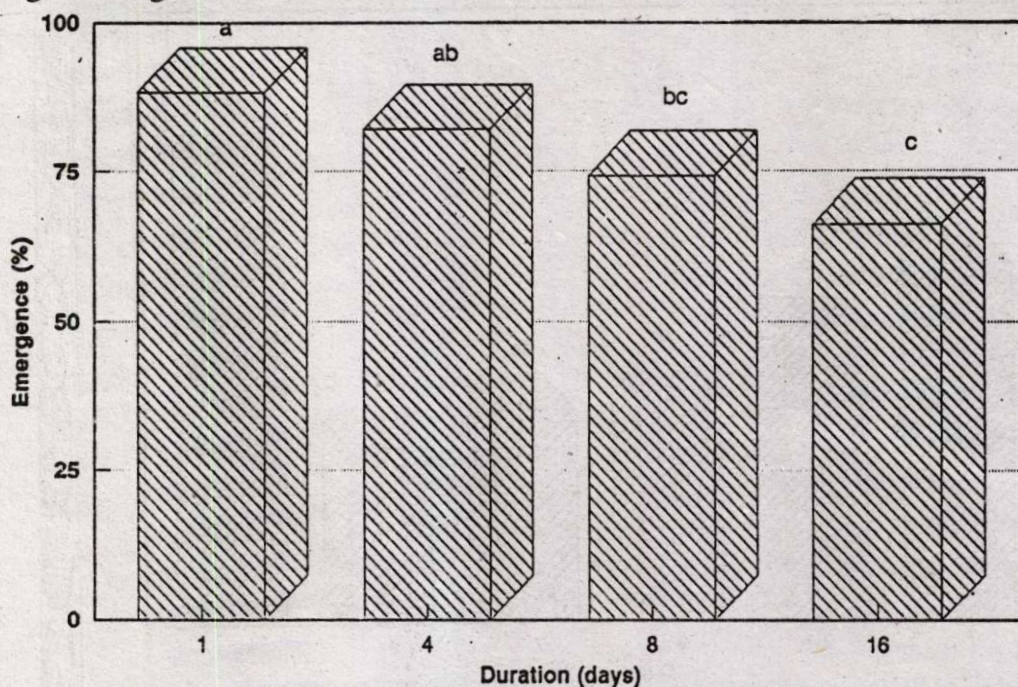


Fig. 5. Radicle emergence of eldarica pine as affected by seed treatment

duration. Bars with different letters are significantly different at $p = 0.05$ using LSD.

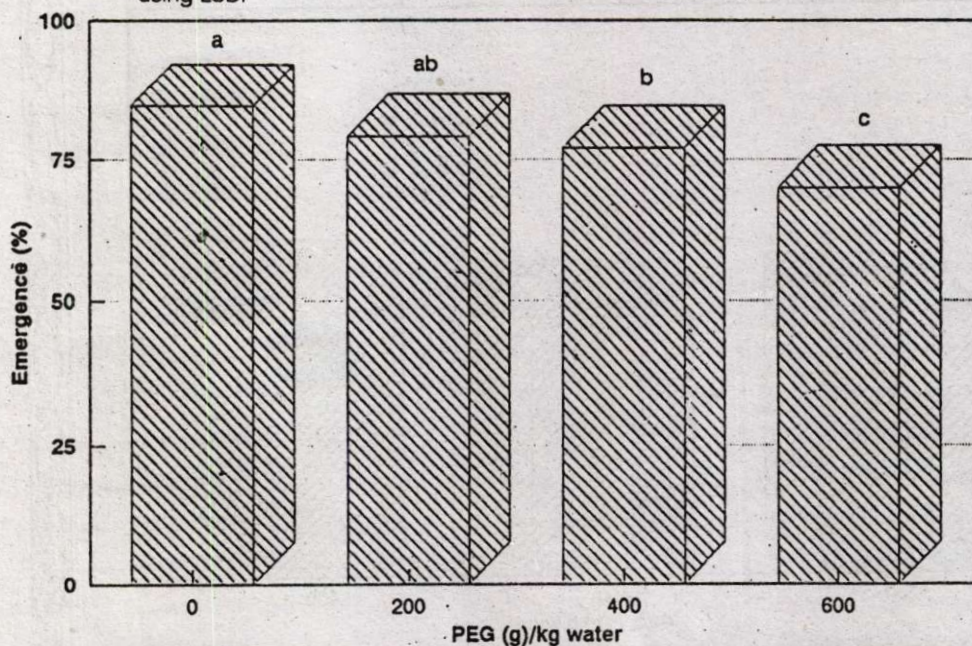


Fig. 6. Radicle emergence of eldarica pine as affected by PEG 8000 concentration

Bars with different letters are significantly different at $p = 0.05$ using LSD.

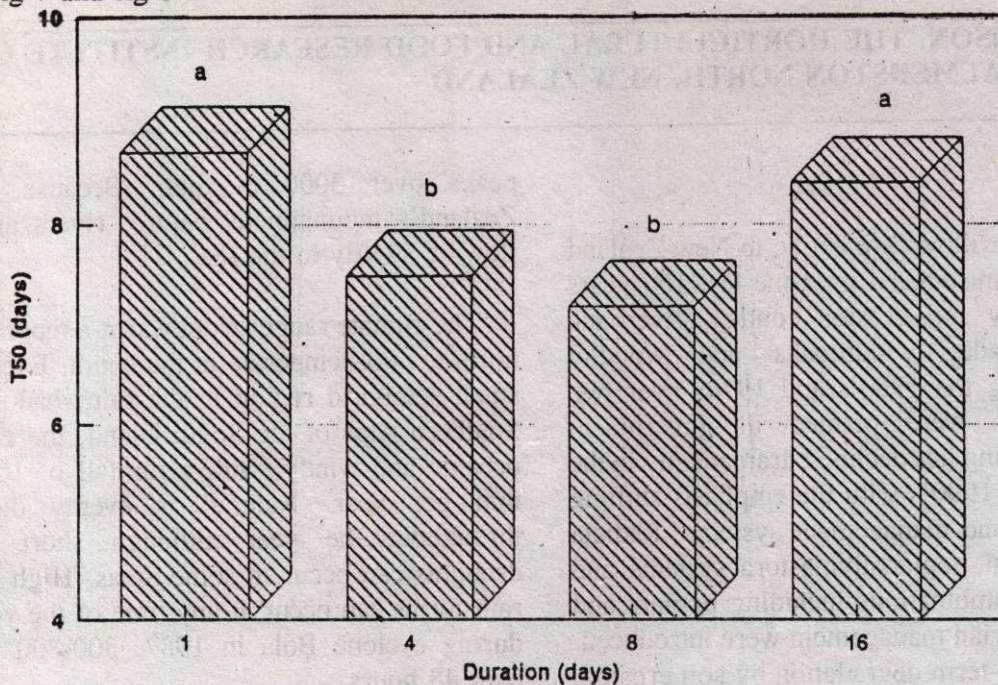


Fig. 7. Days to 50% radicle emergence of eldarica pine as affected by seed treatment duration. Bars with different letters are significantly different at $p=0.05$ using LSD.

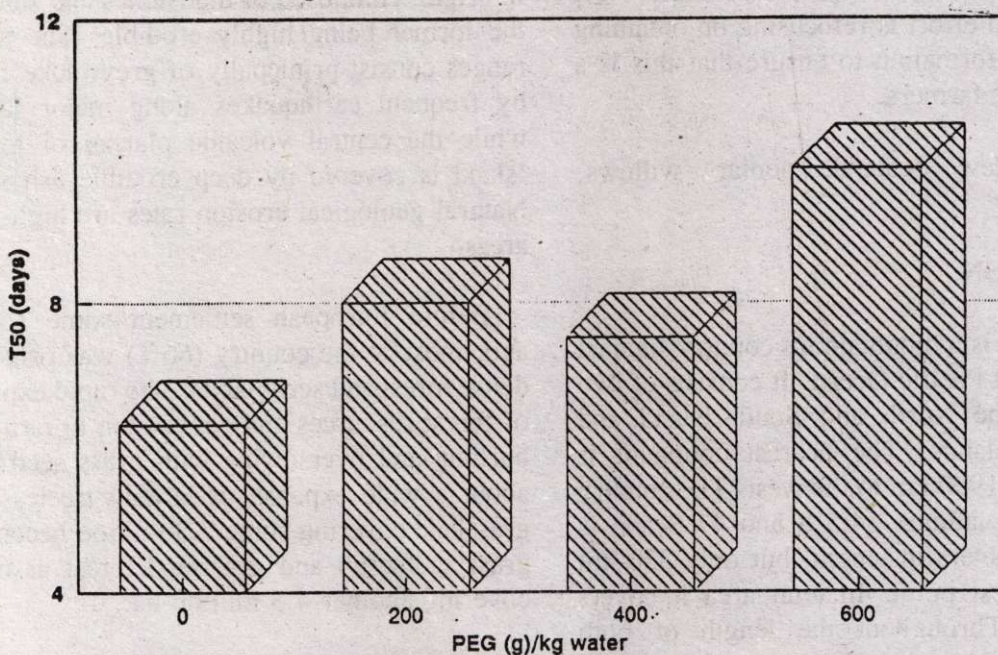


Fig. 8. Days to 50% radicle emergence of eldarica pine as affected by PEG 8000 concentration. Bars with different letters are significantly different at $p=0.05$ using LSD.