EFFECT OF SOWING DATE, IRRIGATION AND WEED CONTROL ON GROWTH AND SURVIVAL OF *PINUS BRUTIA* SEEDLINGS IN NURSERY

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**Abstract:** *Pinus brutia* is one of the most important species for plantation due to its low ecological demands and high tolerance against dry and heat. That is very current in forest plantation in degraded ecosystems and dry and semidry shrub lands in Iran. It is important species for urban green space. This experiment was performed at complete randomized block and factorial design with three treatments, sowing date (20 November and 1 February), irrigation periods (2 and 4 days) and weed mechanical control (7 and 14 days) with four replications and 15 containers (per replications) in Zagheh nursery in Khorramabad of Iran. At the end of the first growing season, height growth, diameter of collar, biomass and survival rate were measured. The results showed that effect of treatments on height growth were insignificant. Effect of irrigation on diameter growth of *Pinus brutia* was investigated and maximum diameter growth was obtained at 2-days. Sowing date and weed mechanical control had no significant difference on diameter growth but survival rate of *Pinus brutia* was affected by all treatments. Biomass significantly was affected by treatments and maximum biomass was at: 20 November date, 2-days irrigation periods and 7-days control periods. Our results was showed that, for decreasing costs of seedlings production in nursery, a longer duration of irrigation, weed control spread to 14-days and increasing of plantation date can be suggested for *Pinus brutia* in Zagheh seedling, Khorramabad.

**Key words:** seed, sowing date, irrigation, weed control, *Pinus brutia*, and nursery

**INTRODUCTION**

*Pinus brutia* Ten. is a forest tree with great ecological and economic importance for the eastern Mediterranean region (Zare, 2001; Fatahi, 1994), and the northeastern coast and several Aegean Sea islands of Greece. It prolifically grows on lime soils and is amply adapted to infertile soils and dry climate (Fatahi, 1994). The geographical distribution of *P. brutia* is from Greek Aegean Islands through Turkey to Lebanon and northern Iraq (Dastmalchi, 1995). This species apparently is similar to *Pinus halepensis* Mill. (Fatahi, 1994). In afforestation, it accommodates well in dry and cold regions, and can be an alternative to *Pinus halepensis* at high altitudes in Mediterranean areas (Nouals, Bariteau, 1993). Today, with incorrect usage, caused decreasing of Zagros forest (Ebrahimi, 1992), development of green space more need. Reduction of indgraded forest, increasing of
quality and improvement of forest mass for wood industry, increasing of product in production unit, creation of forest plantation and preserved forest and design of damaged forest are important purposes of culture narrow leaf species in Iran (Sardabi, 1998). Thus, in this research the effective factors for increasing of production, decreasing of rate of seedling death and cost in nursery including irrigation, weed control and sowing date was investigated. Sowing date that affect on germinate of seed, vitality and growth are very important (Melissa et al., 2000; Thompson, 1984; Babour et al., 2001; Luoranen et al., 2006; Jink et al., 2006). Irrigation improves diameter growth, height growth, vitality of seedling (Matice, 1982; Fotelli et al., 2000; Driessche et al., 2003; Nagakura et al., 2004) and preservation against long drought (Harrington, 1972). Weed mechanic control also has important role in survival, establishment, seedling growth (Luoranen et al., 2006; Zollinger, Quam, 2001) and in quality and quantity of seedling (McCarthy and Reilly, 2001). Thus, in this research the effect of sowing date, irrigation and weed control on *Pinus brutia* was studied.

**MATERIALS AND METHODS**

**Experimental design**

The seeds, provided from Fellahat Garden in Khorramabad, Lorestan province in Iran, were floated in water for 24 h to eliminate the empty ones (Tabatabaii, Ghasriani, 1993). The study design was a $2 \times 2 \times 2$ factorial (with 15 containers in 4 replicate arranged in a completely randomized design). The first factor was sowing date (20 November and 1 February), the second factor was irrigation periods (2-day and 4-day) and the third factor was weed controls periods (7-day and 14-day). With attention to seeds vigor index (%52), 5 seeds were planted in each containers at 20 November and 1 February. Then with starting of dry season, irrigation and weed mechanical control of containers was done from June until Oct.

**Study area**

The study was conducted in a nursery with coordinates 32° 40’ N and 46° 50’ E, approximately 1809 m a. s. l., Located at Khorramabad in south western part of Iran. Mean of annual temperature is 16.3 °C, Average monthly temperature varies from 5.3 °C in January to 27.9 °C in July; mean annual precipitation is 505.7 mm. According to Ambrothermic curve, the dry season lasts from last May until October.

**Measurements**

The measurement of height and collar diameter of seedlings was done on October 2008 (the end of first growing season). The height and collar
diameter was taken with using of a meters and Caliper, respectively, to nearest 1 mm (Hosseini et al., 2007). For each replicate, percentage of seedlings survival was calculated (Mossadegh, 1999). For measurement of biomass, all part of seedling (after cleaning roots with water) put in oven-dried at 70 °C for 48 h until obtaining constant weight (Driessche et al., 2003). The texture of soil used for fill the container was including 53.7% sand, 15.2% silt, and 31.2% clay that were classified in sand-clay-loamy group. The pH and EC of soil was 8.2 and 0.006 mm/cm, respectively.

Statistical Analysis

Kolmogorov-Smirnov normality test was used to test the normality and Levens’ test was used to determine homogeneity of variances. Then due to normal distribution of data that improved by Kolmogorov-Smirnov normality test and equability of variances showed by Levens’ test, the effect of sowing date, irrigation periods and weed control on survival, height, collar diameter and biomass were analyzed using Factorial test and in order to multiple comparison tests was performed. Software including Excel, Microsoft Office 2007, and SPSS version 13.5 (SPSS Inc., Chicago, IL, USA) were used for data manipulations and statistical analysis.

RESULTS

No significant difference was found in height among sowing dates (df=1, ms=.108, F=.087, p>0.05), irrigation periods (df=1, ms=3.989, F=3.204, p>0.05) and weed control periods (df=1, ms= 3.985, F= 3.201, p>0.05).

There was no significant difference between sowing dates (df=1, ms=.204, F=3.657, p>0.05) and weed control periods (df=1, ms= 0.056, F=1.009, p>0.05) on collar diameter seedlings, but irrigation periods had difference on collar diameter (df=1, ms=0.07, F=12.684, p<0.01). Seedlings irrigated in 2-day reached greater collar diameter than 4-day.

There was significant difference in biomass among sowing dates (df=1, ms=9.162, F=44.794, p<0.01), irrigation periods (df=1, ms=3.75, F=27.260, p<0.01) and weed control periods (df=1, ms=3.5, F=25.443, p<0.01). The seeds sown in November, 2 days irrigated, 7-day weeding reached higher biomass.

There was no significant difference in survival seedling among sowing dates (df=1, ms=11.681, F=0.671, p>0.05), irrigation periods (df=1, ms=8, F=0.0459, p>0.05) and weed control periods (df=1, ms=50, F=2.871, p>0.05).
There was no significant difference in height, on 20 November and 1 February date, 2-day or 4-day irrigation periods and 7-day or 14-day weed control. The insignificant effect of sowing date, and irrigation period and weed control on seedlings height of *Pinus brutia*; probably is due to tolerant, adaptation, low requirement to environmental conditions (Dastmalchi, 1995)
for example temperature and moisture of soil and change of climate. Our results were not similar to some finding of other researchers. Thompson (1984) with a study on *Pseudotsuga menziesii* and *Pinus elliottii*, Luoranen et al. (2006) with a study on *Picea abies*, and Kiasari et al. (2006) with a study on *Pinus radiata* indicated that sowing date on height growth had significant effect which the amount of height was greater in early sowing date. Timmer, Miller (1991) with a study on Red pine and Tabari et al. (2006) with a study on *Cupressus sempervirens* mentioned that water stress causes decreasing of height seedlings. Reverse our results, Hosseini et al. (2007) showed that

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**Fig. 3.** Effect of treatments on survival percent. Values in columns indicated with same letters are insignificantly different (p> 0.05)

**Fig. 4.** Effect of treatments on amount of biomass. Values in columns indicated with different letters are significantly different (p< 0.05)
effect of weed control on height of *Pistacia atlantica* was significant. In other study, Neary et al. (1990) showed that weed control had no significant on height of loblolly pine and slash pine.

In our results seedlings collar diameter was not different in sowing dates and weed control treatments. These results are not similar to the results obtained by Thompson (1984) on *Pseudotsuga menziesii* and *Pinus elliottii* who indicated seedlings collar diameter was greater in early seed sowing dates. Probably, early sowing date was affected on establishment of seedlings with favourable growing condition, before dry season begins and soil moisture becomes limiting. Hosseini et al. (2007) showed sowing date had significant effect on collar diameter growth of *Pistacia atlantica*. It seems that these differences might be because of species differences. *Pistacia atlantica* is a higher ecological needs species than *Pinus brutia* that is a tolerant species and not sensitive than winter cold and dry season (Fatahi, 1994; Nouals, Bariteau, 1993). Weed control had no significant effect on collar diameter, but irrigation significantly had effect on collar diameter which was greater for seedlings irrigated 2 days. Tabatabai (1970) showed that the growth of this species in optimum condition was higher. Neary et al. (1990) showed that growth of loblolly pine and slash pine species are not different with weed control but Haywood et al. (2003) with a study on loblolly pine revealed that weed control increased seedlings growth which this results was incoherence with our findings, that it because of *Pinus brutia* is a tolerant species and not sensitive. There was significant difference in biomass among sowing dates, irrigation periods and weed control. Average maximum biomass was on 20 November, 2-day irrigation period and 7-day weed control. These results were similar to the finding of Gautam et al. (2003) – they showed seedlings biomass of *Pinus radiate* was greater in optimum conditions moisture and temperature. Also Sorenson (1978) reported greater biomass of *Pseudotsuga menziesii* seedlings was in early seed sowing dates. Biomass amount in 2-day irrigation period was more than 4-day irrigation period. Our results were similar to the findings of Timmer, Miller (1991) on Red pine, and Gautam et al. (2003) on *Pinus radiata* that indicated seedlings biomass affected by water stress was lower. In the same research Haywood et al. (2003) found that weeding operation improved the growth seedlings of loblolly pine. There was a competition between seedlings and weed for gain moisture, nutrition, light and space (Zollinger, Quam, 2001; Ayeni, 2003; McCarthy, Reilly, 2001). Thus 7-day weed control decreases weed competition of *Pinus brutia* seedlings. Jason et al. (2002) also revealed the biomass of that *Pinus teada* to be greater in the treatment with weed control operation. Haywood et al (2003) reported weed control had significant effects on growth of loblolly pine seedlings.

There was no significant difference in survival between sowing dates, irrigation, and weed control. Our results were incoherence with the findings
of Thompson (1984) on *Pseudotsuga menziesii* and *Pinus elliottii*, and Babour et al. (2001) on *Pinus teada*, but similar to the finding of Hosseini et al. (2007) on *Pistacia atlantica*. This finding probably is because of *Pinus brutia* had not special requirements to water and soil (Dastmalchi, 1995) and had been tolerated to dry and bad conditions of environment. Also irrigation was insignificant on survival because *Pinus brutia* is a tolerant species and can grow on lime, sand and stone lands (Dastmalchi, 1995). Cleary et al. (1978) was revealed that the optimum moisture of soil either with irrigation or with rainfall especial in dry season can be increase the seedling survival. Also Matice (1982) revealed irrigation significantly increases seedlings survival but in this study with attention to physiologic and ecologic characteristics of *Pinus brutia* seedlings that it was a tolerant species (Dastmalchi, 1995), weed competition could not decrease the survival of seedlings. Harrington et al. (2004) indicated that effect of weed control on seedlings survival of *Cupressus arizonica* was not significant.

**CONCLUSION**

The results of this study indicate that early sowing date was better because it lead to greater biomass as compared to delayed sowing. 2-day irrigation periods showed better results such as greater collar diameter than those of 4-day irrigation periods. Our results revealed no significant differences of weed control on height, collar diameter, and survival. Manager of Zagheh nursery can save using weed control spread to 14-day long periods of irrigation and increasing of planting date.

**REFERENCES**


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**ЕФЕКТ НА ДАТАТА НА ЗАСАЖДАНЕ, ПОЛИВАНЕТО И КОНТРОЛА НА ПЛЕВЕЛИТЕ ВЪРХУ РАСТЕЖА И ПРЕЖИВЯЕМОСТТА НА ФИДАНКИ ОТ PINUS BRUTIA В РАЗСАДНИК**

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(Резюме)

Pinus brutia е един от най-важните видове за залесяване поради малките екологични изисквания и високата толерантност към засушаване и топлина. Това е причина га се използва често при залесяване на деградирални екосистеми и сухи или полусухи площи в Иран. Също така е важен вид за градските зелени пространства.

Този експеримент е изпълнен като пълен рандомизиран блок и подбор на факторите, с три третирания, дати на засяване (20 ноември и 1 февруари), периода на поливане (2 и 4 дни) и механичен контрол на плевелите (7 и 14 дни), с 4 повторения и 15 контейнера (за повторенията) в разсадника Заге в Хорамабад, Иран. В края на първия вегетационен период бяха измерени прирастът по височина, диаметър, биомасата и преживяемостта.

Резултатите показваха, че ефектът от третиранията е незначителен.
Беше изследван ефектът от напояването върху прираста по диаметър на *Pinus brutia* и максимумът му беше на 2. ден. Датата на засаждане и механичният контрол на плевелите нямаха съществен принос към растежа по диаметър, но преживяемостта на *Pinus brutia* беше повлияна от всички третирания. Биомасата беше значително повлияна и максимумът й беше при засаждане на 20 ноември, 2 дни поливане и 7 дни контрол на плевелите. Резултатите показваха, че за намаляване на разходите за производство на фиданки от *Pinus brutia* в разсадника Заге в Хорамабад, могат да се препоръчат по-ранно засаждане, по-дълъг период на поливане и контрол на плевелите до 14 дни.

**Ключови думи:** семена, дата на засаждане, поливане, контрол на плевелите, *Pinus brutia*, разсадник