MODERN TECHOLOGIES OF IRRIGATION OF SPRUCE (*PICEA ABIES*) CULTURES FROM SOLARIUMS

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Abstract. Irrigation water quality is the most critical factor in tree nursery management. The present paper has as object of study modern technologies of irrigation of spruce cultures (*Picea abies*) from the solariums.The aim of the paper was determining the height of irrigated seedlings with plain water compared with those irrigated with energized water and implicitly, any differences regarding their vigor of growth. After statistical data processing, it was found that irrigated seedlings with energized water have superior values for main measured parameters. After a vegetation season, the height mean of irrigated seedlings with energized water is of 14,48 cm in a year, while irrigated seedlings with plain water registered an mean height value of 9,6 cm. Following these measurements, it is recommended to irrigate spruce cultures with energized water because the values obtained through this method are clearly superior to the one in which plain water is used. By using this method of irrigation, it is possible to obtain seedlings with larger dimensions and, implicitly, a much better result of repication and of their subsequent development. Another advantage would be the fact that these seedlings irrigated with energized water have a superior state of health compared to the others, due to lack of harmful substances (carbon dioxide, nitrites, residual chlorine) from the water used for irrigation.

Keywords*:* energy devices, seedlings, nursery, repication

INTRODUCTION

Forest tree and native plant nurseries grow seedlings for reforestation and restoration projects. Given that the seedlings are typically planted in projects that have environmental objectives, nursery growers want to ensure that the plants are grown in a sustainable manner (Rebecca Sheridan *et al*., 2016). Growing seedlings in a nursery requires resources, including water. Developing more water-efficient practices to grow plants can reduce the nursery's water use (Landis, 1989; Landis and Wilkinson, 2004).

Water is an essential component of plants. It aids in the movement of substances throughout the plant, serves as a medium for chemical reactions, and is necessary for photosynthesis. Day 1984, says the water is managed in forest-tree nurseries to control available soil moisture and foster germination, growth, and specific physiological responses, provide solutions for transporting and infiltrating water-soluble fertilizers and leaching excessive salt concentrations, protect crops from extreme drought, soil heating, freezing, or frost heaving. Soil texture and depth, depth of root development, and soil moisture content govern the amount of water to be applied at any irrigation (Landis, 1982).

Water is the single most important biological factor affecting plant growth and health. Water is essential for almost every plant process: photosynthesis, nutrient transport, and cell expansion and development. In fact, 80 to 90 percent of a seedling's weight is made up of water. Therefore, irrigation management is the most critical aspect of nursery operations (Landis and Wilkinson, 2009).

Determining how, when, and how much to irrigate is a crucial part of nursery planning as well as day-to-day operations. One missed watering session can cause serious

injury and even death to plants at any stage in their development (Davis, 2008). Overhead irrigation is the most common form of irrigation in forest and conservation nurseries (Landis and Others, 1989) and in greenhouse production overall (Leskovar, 1998). Overhead irrigation systems are generally less expensive to install, and have the advantage of preventing the accumulation of fertilizer salts that can be detrimental to plant growth (Argo and Biernbaum, 1995).

In forestry nurseries it is being arraged frequently, as sheltered spaces, solariums, that can be fixed or mobile and rarely hotbeds and cold (temperatures of 5-6°C) or temperate greenhouses in which the temperature maintains itself, through artificial heating, between 12-16°C. The solariums are fixed or mobile constructions in which the heat and light source is the solar energy and have the role of protecting the plants.

The present paper has as object of study modern technologies of irrigation of spruce seedlings (*Picea abies*) from solariums. The aim of the paper was to determine the difference in height between seedlings irrigated with plain water and those irrigated with energized water, with the help of Ancu Dincă (DEA) devices and implicitly, some aspects regarding their vigor of growth.

MATERIALS AND METHODS

Biological material. In this study, the growth and development of spruce seedlings (*Picea abies*) in solariums was pursued, using two different irrigation methods. The spruce seeds were sown in two solariums in spring of year 2016, and after the emergence of the plantlets, as system of irrigation, in a solarium was used plain water, and in the second solarium was used energized water with help of Ancu Dincă (DEA) devices.

The devices were glued to the tops of an isosceles triangle on a plastic container filled with water, throughout the entire period of the vegetation season, period in which the necessary measurements and determinations for the study were made (Fig. 2). In each solarium was chosen a number of three sample markets with the surface of one square meter and the height was measured at a number of 50 seedlings from each market (Fig.1).

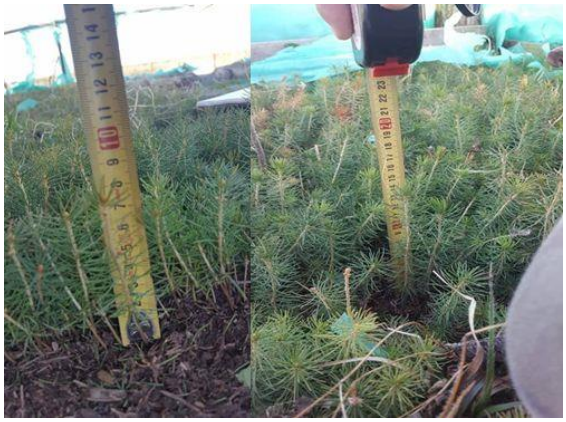


Fig. 1. Measuring the height of seedlings with roulette

Fig. 2. Placing of water energy devices (DEA) on containers

The two solariums in which the measurements were made are situated in the Lita Nursery, Cluj-Napoca county. Lita Nursery is situated at the foots of Apuseni Mountains,

the relief being formed by intramontane depressions, at an altitude of 625 m. Biogeographic it is situated in the continental region having geographical coordinates: lat. N 46º 40' 21" and long. E 23º 27' 18".

Statistical analyses. Data were processed as mean values, calculating the variability of the analysed traits. In this way, a statistical analysis of variation was performed-ANOVA, using the ”t” test, considering the mean of experience as control. The variability of the analysed peculiarities in the experience was noted based on the coefficients of variability. Also, based on these coefficients (CV<10% -low variability; 10% <CV <20% -medium variability; CV>20%- high variability) the uniformity of the traits considered in the study was assessed for all the provenances.

RESULTS AND DISCUSSION

The „t” values obtained from the calculations were compared with the theoretical „t” values, corresponding to the degrees of freedom of the variants considered. The significance of the differences between each variant and witness (the mean of the experience) were established according to the „t” values obtained.

The height of the seedlings irrigated with plain water, measured at the end of month June 2016, registered very significantly lower values (7.52 cm) compared to the seedlings irrigated with energized water, that registered significantly higher values (9.64 cm), the mean of the experience being of 8.54 cm (Fig. 3).

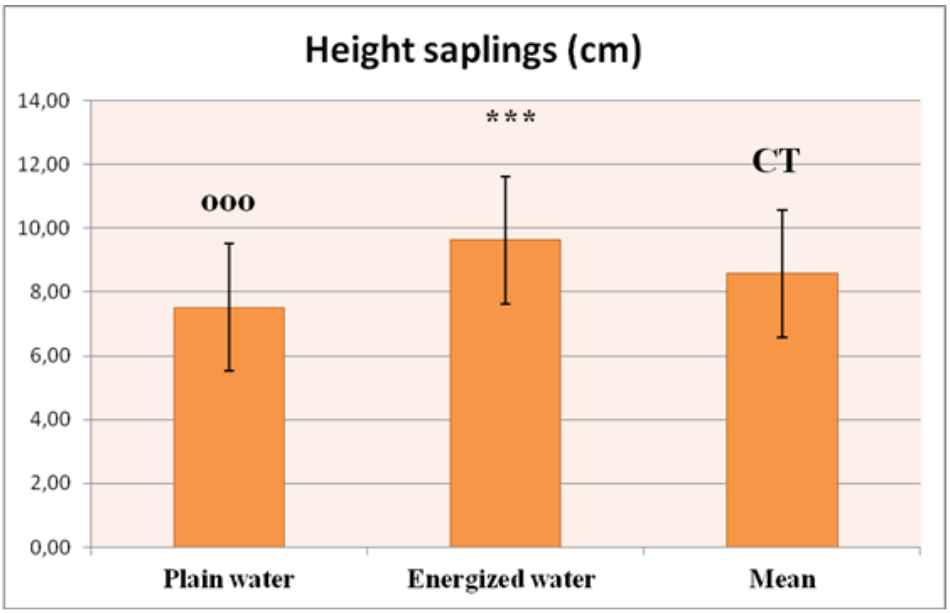


Fig. 3. Synthesis of results regarding spruce seedlings` height at the end of June 2016

At the end of month September, 2016, as well as at the end of June 2016, very significantly lower values of seedlings` height were registered at seedlings irrigated with plain water (8.97 cm), compared with seedlings irrigated with energized water, that registered significantly higher values (14.49 cm), mean of the experience being of 11.73 cm (Fig. 4).

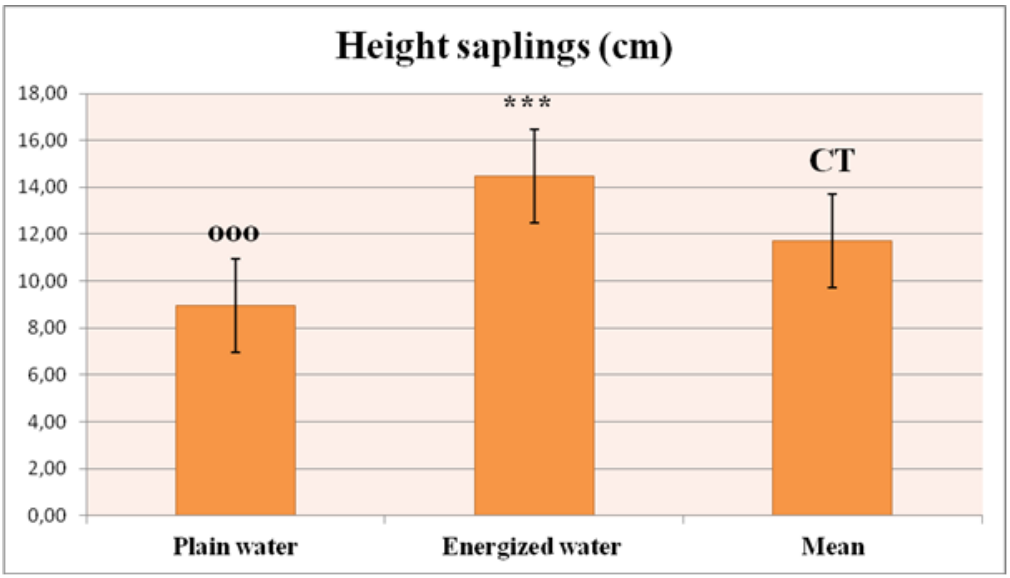


Fig. 4. Synthesis of spruce seedlings` height results at the end of month September 2016

With the help of histograms it is highlighted the frequency of seedlings` height that shows that most seedlings have a height between 7.5 and 8 cm and a minimum between 6.5 and 7 cm, in case of irrigation with plain water. Regarding the frequency of seedlings` height irrigated with energized water, it is noticed that values are dispersed between 8 and 11.5 cm, a higher number of seedlings is recorded at values from the middle, respectively 9.5-10 cm and we have the fewest with heights between 8-8.5 cm (Fig. 5).

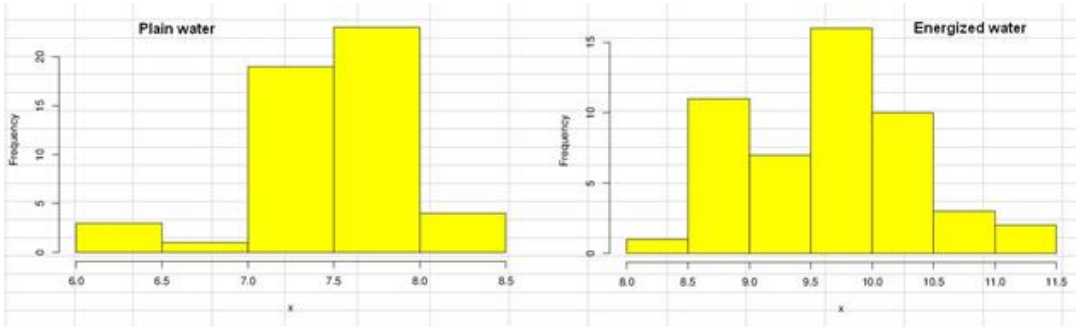


Fig. 5. Histogram regarding frequency of seedlings` height from month June 2016

Histograms regarding the frequency of seedlings` height irrigated with plain water from month September, 2016, recorded an agglomeration of heights between 9 and 9.2 cm, and the lowest frequency is represented by heights between 9.4 and 9.6 cm, which means that the seedlings are very uniform in terms of height. Seedlings irrigated with energized water recorded very high height values, reaching up to 16 cm, but their largest frequency is between 14 and 14.5 cm and the lowest frequency of heights is distributed between values 15.5 and 16 cm (Fig. 6.).

As a result of the statistical calculations, it can be observed that, in both cases (months June, respectively September), seedlings that have been irrigated with plain water, have very low values compared with those irrigated with energized water.

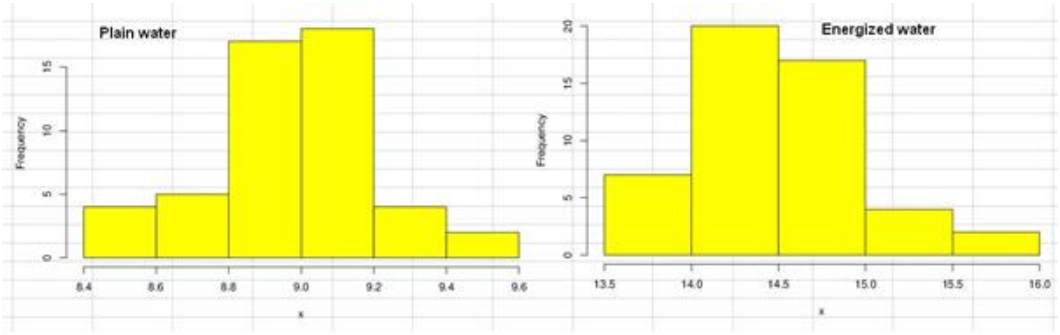


Fig. 6. Histogram regarding seedlings` height frequency from month September 2016

The coefficient of variability regarding seedlings` height recorded low values in case of plain water (5.58 in June, respectively 2.61 in September), and in case of seedlings irrigated with energized water it recorded higher values (7.11 in June and 3.10 in September). The mean of the coefficient of variability showed a low values, which indicates a small variation of the analysed character (Tab. 1.).

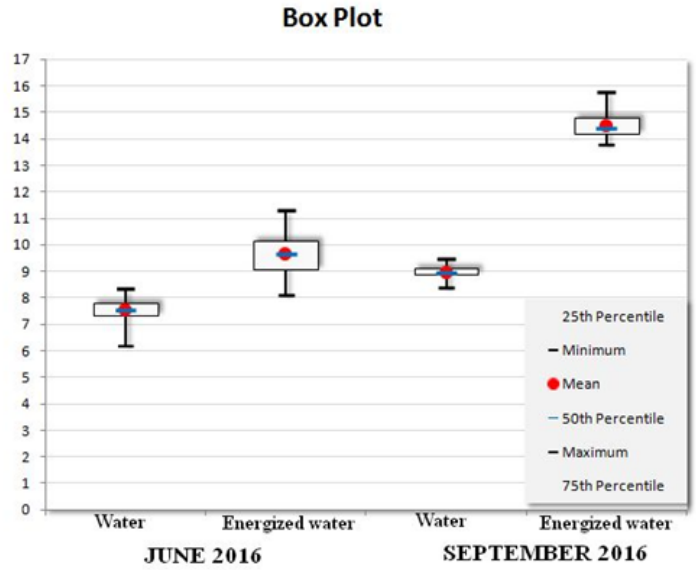
In the boxplot below the evolution of seedlings` height is represented both at the end of month June 2016 as well as at the end of month September, 2016. In month June 2016 a minimum of 6.2 cm can be noticed and a maximum of 8.3 cm in case of seedlings irrigated with plain water and a value between 8.1 and 11.3 cm in case of seedlings irrigated with energized water.

Table 1

Synthesis table regarding descriptive statistics of variance coefficient

	Water	Energized water	Water	Energized water
Sample size (N):	50	50	50	50
Arithmetic mean:	7.52	9.64	8.97	14.49
Geometric mean:	7.50	9.61	8.96	14.48
Harmonic mean:	7.71	9.74	8.96	14.66
Median:	7.53	9.65	8.98	14.43
Range:	1.03	3.15	0.77	1.85
Variance:	0.18	0.47	0.05	0.20
Standard deviation:	0.42	0.69	0.23	0.45
Coefficient of variation:	5.58	7.11	2.61	3.10
Standard error of the mean:	0.06	0.10	0.03	0.06
95% confidence interval:	0.12	0.19	0.07	0.13
Upper 95% confidence limit:	7.64	9.83	9.03	14.61
Lower 95% confidence limit:	7.40	9.44	8.90	14.36

Also, in month September, 2016, it can be noticed an evolution of heights from 8.4 up to 9.5 cm at seedlings irrigated with plain water and from 13.8 up to 16 cm in case of seedlings irrigated with energized water.



	Water	Energized water	Water	Energized water
25th Percentile	7	9	9	14
Minimum	6	8	8	14
Mean	8	10	9	14
50th Percentile	8	10	9	14
Maximum	8	11	10	16
75th Percentile	8	10	9	15

CONCLUSIONS

Taking a synthesis of these data, it can be said that, seedlings that have been irrigated with energized water with help of Ancu Dină (DEA) devices have a much greater growth in height than the other seedlings, the difference being up to 5-7 cm. This fact is particularly important because in application of solar-repication technology, for a good success, the sizes of the seedlings (especially their height) play an extremely important role. Also, the growth vigor, superior within these seedlings, has a special importance in accomplishing successful crops. The seedlings were replicated, in spring of year 2017 in Șoimu-Valea Ierii Nursery, the percentages of netting being well favorable to seedlings irrigated with energized water. As such, it is recommended the use of these devices to energize the water used in solarium cultures and, if possible, their extention also in case of cultures from repication sections, with the possibility of reducing the duration of maintenance of seedlings in repication from two to one year.

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