WATER NEEDS OF ELDERBERRY (*SAMBUCUS NIGRA* L.) IN FIRST THREE YEARS OF GROWING IN DIFFERENT REGIONS OF POLAND

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Abstract. Elderberry (*Sambucusnigra* L.) is a common species belonging to the *Adoxaceae* family native to most of Europe and North America. For centuries, elderberry has been used as a medicinal plant. This species is also a popular ornamental plant often grown in the gardens and city parks. However, the seedling survival rate of elderberry depends mainly on the suitable soil water conditions that can be controlled using a properly designed and operated microirrigation system. Firstly, it is necessary to determine the water needs of *Sambucusnigra* L., especially in the first period of growth, which determines the seedling survival rate of the plants introduced into the gardens or parks. A commonly accepted measure of the plant water requirements is the potential evapotranspiration of this plant. The purpose of the research was to assess the water needs of *Sambucusnigra* L. during the first three years of its growing in five different regions of Poland. Potential evapotranspiration of the elderberry was calculated using modified by Żakowicz for Polish conditions the Blaney-Criddle's method, to which the crop coefficients were adjusted. The study was carried out for thirty years, from 1981 to 2010, in five different agro-climatic regions of Poland.The largest water needs in the period of increased demand for water in elderberry (June-July) occurred in the central-north-western (232 mm) and central-eastern (230 mm) regions. The lowest water needs were found in the south-eastern region (214 mm). The highest rainfall deficit in the central-north-west region (102 mm), smaller rainfall deficit in the central-eastern and south-western regions, amounted to 82 mm and 72 mm, respectively. The lowest rainfall deficit (40 mm) was found in the south-eastern region.In the central-north-west and central-eastern regions, precipitation deficiency occurred in 28 out of 30 considered years (93 % years). In the south-eastern region, precipitation deficiency occurred in 21 years (70 % of years).

Keywords : irrigation, evapotranspiration, reclamation, seedling survival, water requirements.

Introduction

Elderberry (also called medicinal lilac) is a popular plant used for centuries for medicinal purposes [1; 2]. Sometimes it is cultivated – as an ornamental shrub – also in parks and home gardens. High Elderberry planting – on the surface of the park or within a given garden – depends primarily on optimal water conditions that can be effectively shaped using properly programmed and operated microirrigation. However, this requires the necessary prior determination of the needs of water plants, especially in the first – decisive for the success of the plantings carried out – the period of growth of plants introduced into the area of a given park or garden.

The objective of the present research was to estimate of the water needs of elderberry (*Sambucusnigra* L.) at the first three years of growing on reclaimed land in different regions of Poland.

Materials and methods

The potential evapotranspiration of this plant is considered to be a commonly accepted measure of water requirements by a given plant. Potential evapotranspiration of the elderberry was calculated using modified by Żakowicz for Polish conditions the Blaney-Criddle's method, to which the crop coefficients were adjusted [3]. The water requirements of elderberry were measured during the growing; from April 1 to October 31. The study was carried out for thirty years, from 1981 to 2010, in different agro-climatic regions of Poland [4].

Results and discussion

In all analyzed regions in the period of 30 year, from 1981 to 2010, there was a tendency to increase the water needs of elderberry during increased demand for water in the months of June-July (Fig. 1). On average, in the years 1981-2010 and Polish 5 regions considered, the demand for water in elderberry in the period (June-July) increased by 5.4 mm in each decade. It is worth noting that – with the exception of the central-north-west region – the mentioned trend of time variability of water needs was significant (for $\alpha = 0.01$, i.e. for the probability of 99 %) in each region. In each decade of the

thirty years, the needs of elderberry in the period from June 1 to July 31 increased in the range from 3.6 mm (central-north-west region) to 6.2 mm (south-eastern region). In other regions, the increase in each decade was 5.4 mm in the north-east region, 5.9 mm in the central-eastern region and 6.0 mm in the south-west region.

The highest water needs in June-July occurred in the central-north-western (232 mm) and central-eastern (230 mm) regions (Fig. 2). The lowest water needs were found in the south-eastern region (214 mm). The largest rainfall deficit in June-July occurred in the central-north-west region (102 mm), smaller rainfall deficiencies occurred in the central-eastern and south-western regions, and amounted to 82 mm and 72 mm, respectively. The lowest rainfall deficiency (40 mm) was found in the south-eastern region.

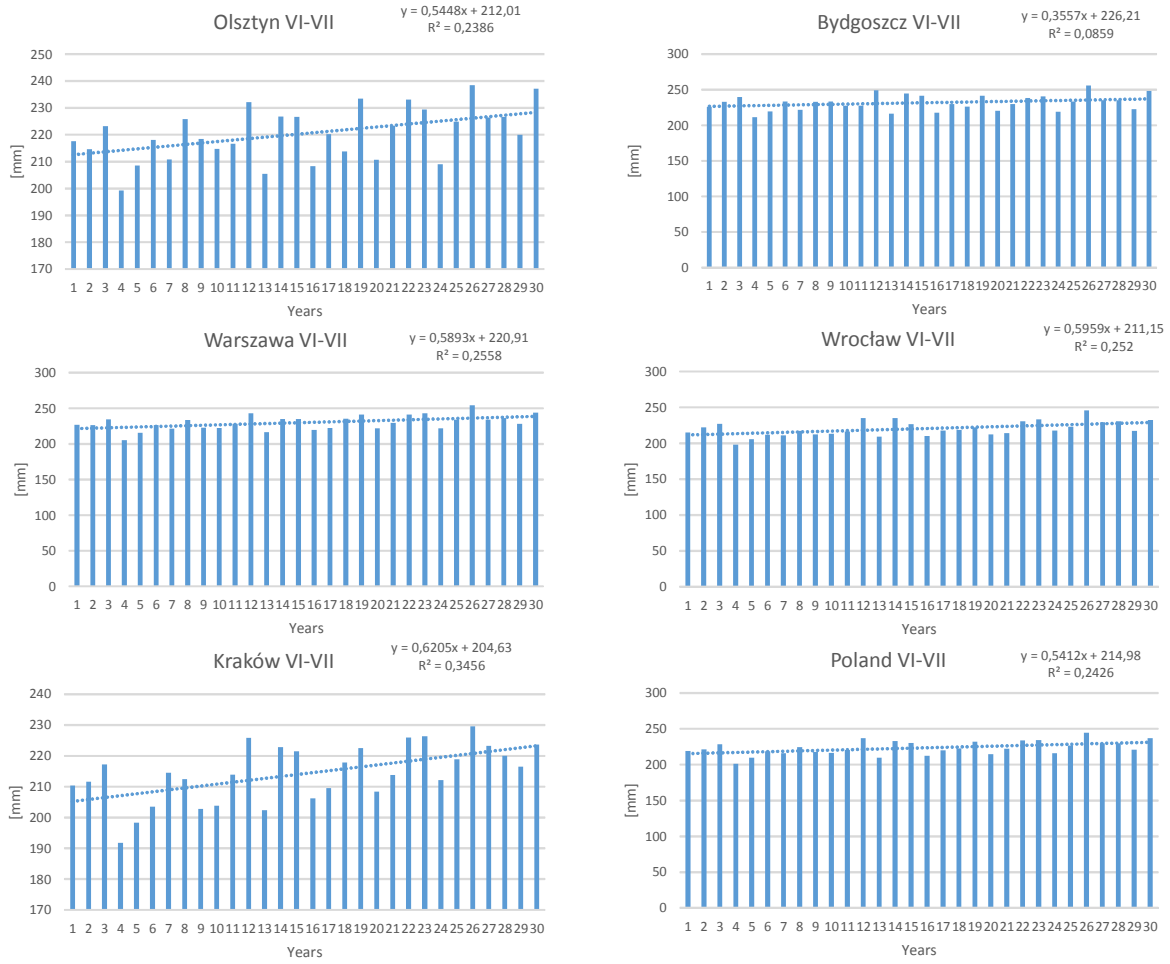

Fig. 1. **Time trend of elderberry water needs in period June-July in different regions of Poland (*n* = 30; *p* = 95 %)**

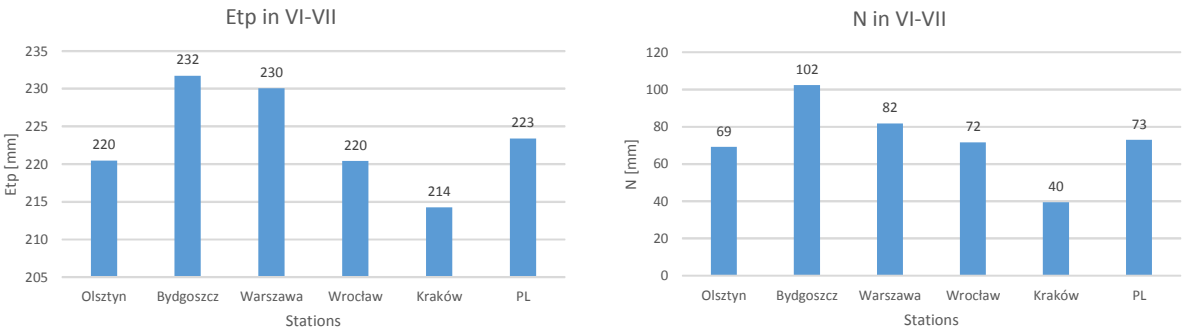

Fig. 2. **Long-term (1981-2010) average water needs (Etp) and rainfall deficiency (N) of elderberry in period June-July in different regions of Poland**

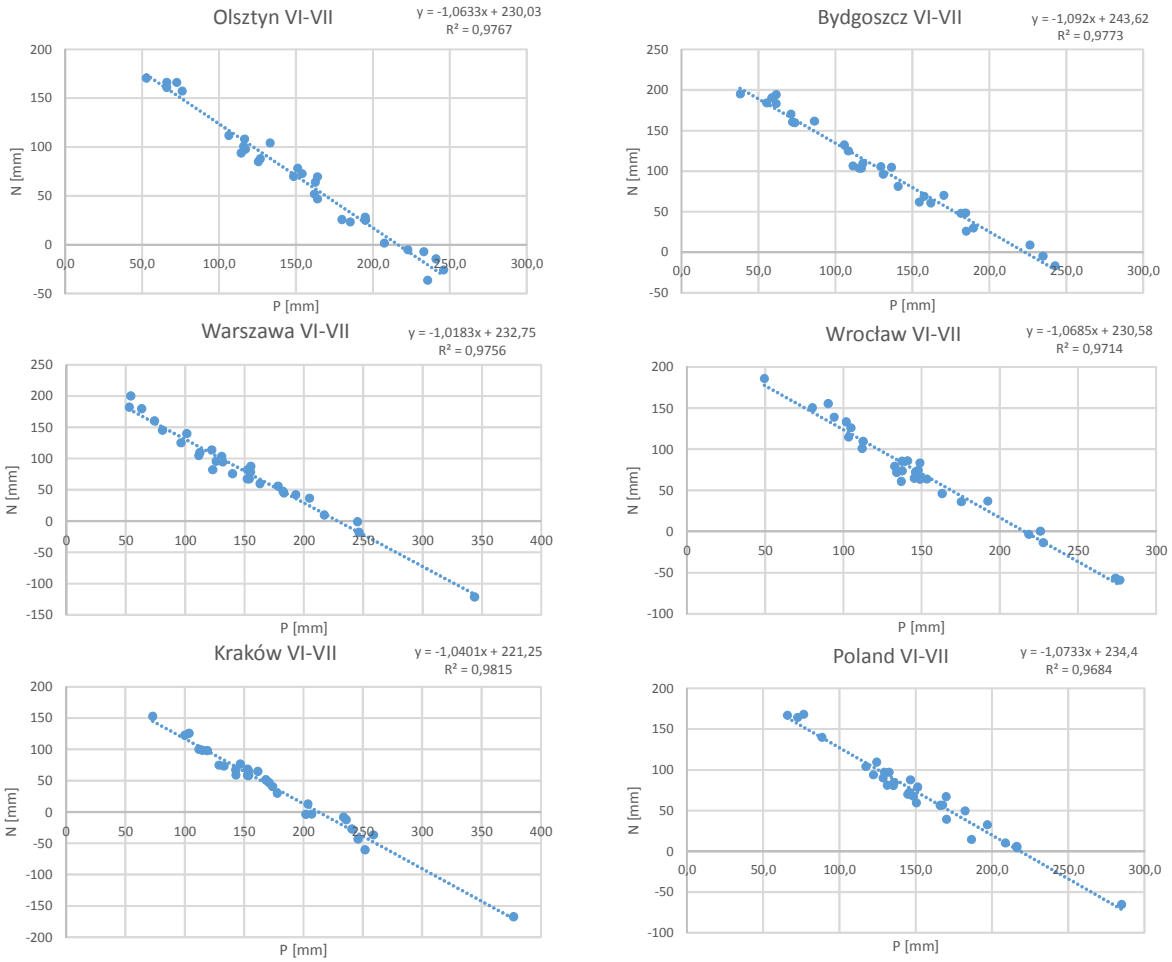

Fig. 3. **Relationship between precipitation totals (P) and rainfall deficit or excess (N) of elderberry in period June-July in different regions of Poland (*n* = 30; *p* = 95 %)**

Relations between the precipitation totals and deficiencies (or excess) of precipitation in the June-August period in the analyzed 30-year period are shown in Figure 3. Deficiency of precipitation, on average in Poland, occurred in 29 years. In the central-north-west and central-eastern regions, deficiency of rainfall occurred in 28 years. In the south-eastern region, rainfall deficiency occurred in 21 years.

Elderberries grow on all substrates, but preferably on medium dry to wet stands [5]. Elderberries are not drought tolerant [6; 7]. But, on the other hand, elderberries are able to recover from short periods of water shortage (at least up to three weeks) [8]. Elderberries maintained stem water potential by reducing leaf conductance soon after the onset of drought, by closing stomata [9]. The usefulness of micro-irrigation treatments in the growing of elderberry on the reclaimed land has been confirmed in the field studies in Poland [3; 10]. Drip or trickle irrigation is commonly used to irrigate elderberry in the USA [6; 7].A positive response of elderberry to irrigation was also found in Hungary [11].

In the conducted research, it was found that in allstudied regions of Poland in the period of 30 years from 1981to 2010, there was a tendency to increase the elderberry water needs in the growing season. This is confirmed in the literature [4], where it is anticipated that climate changes will lead to an increase in the water needs of plants in the near future, including plants growing on reclaimed land. This creates the need to undertake a number of adaptation activities. One of such effective actions will certainly be irrigation, the importance of which – together with the intensification of adverse climate changes – will grow even more [4; 12-17].

The results obtained in the study may be helpful in the designing and arranging of the irrigation system of elderberry at the first three years after planting. The irrigation is one of the most important melioration techniques enabling the proper development of the tree and shrub seedlings in the forest nurseries and other plantings [18; 19].

The beneficial effect of irrigation treatments and other melioration revitalizing methods on the seedling growth of tree species such aslittleleaf linden [20] or paulownia [18] was observed in the experiments performed in the region of Bydgoszcz.

Conclusions

1. The largest elderberry water needs in the period of increased demand for water (June-July) occurred in the central-north-western (232 mm) and central-eastern (230 mm) regions. The lowest water needs were found in the south-eastern region (214 mm).
2. The highest rainfall deficit in the central-north-west region (102 mm), smaller rainfall deficit in the central-eastern and south-western regions, amounted to 82 mm and 72 mm, respectively. The lowest rainfall deficit (40 mm) was found in the south-eastern region.
3. In the central-north-west and central-eastern regions, precipitation deficiency occurred in 28 out of 30 considered years (93 % years). In the south-eastern region, precipitation deficiency occurred in 21 years (70 % of years).

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