Economic efficiency of *Thuja* plants propagation by cuttings

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Abstract. High interest in ornamental plants as an element of landscaping has been actively going on in recent years. In urban green construction, it is increasingly possible to meet not native local species, but introduced plants, which in urbanized environments are in many cases more stable and durable. For several years, we have been studying the selection of root formation stimulants, as well as their necessary concentration for treating cuttings of *Thuja occidentalis* forms. As a result of the calculation of economic efficiency, an increase in profitability was revealed when using phytohormones compared with the control. As an effective growth stimulator, the IBA (indole-buteric acid) drug (100 mg/l) was chosen. The use of IBA auxin (100 mg / l) allows to increase the profitability of production and provides a high yield of planting material with minimal costs.

1 Introduction

In recent years, the demand for introduced coniferous ornamental plants for landscaping homesteads and urban areas has increased [1]. Due to the increased popularity of introduced plants for planting as solitares in urbanized areas, it can be concluded that in urban gardening and park construction, exotics clearly prevail over native plant species. In conditions of urbanization, introduced plants are in many cases more stable and durable than plants of the local area of growth. The use of introducents for landscaping in urbanized areas increases the aesthetics, sanitary and hygienic properties of the environment. The application of auxins in the rooting of exotics helps to reduce the cost of planting material production [2-5]. In the conditions of the forest-steppe zone, coniferous plants of the *Thuja* L. genus can be recommended as exotics for garden and park construction. Among them are *Thuja occidentalis* L. – as a rule, slow-growing long-lived evergreen trees of the cold regions of eastern North America. They grow well in places where there is a lot of snow [6]. In the collection of the VNIISPK arboretum, several forms of western thuja have been growing since 1968, introduced to us from the eastern part of North America [7-9]. Mainly coniferous plants of the *Thuja* genus are planted because of the high degree of decorative properties that are inherent in these plants throughout the year. The needles of these plants contain phytoncides that effectively purify the air. The *Thuja* genus has a large number of species and forms that can be used for gardening in the form of solitares, line plantings and

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in groups, both with conifers and deciduous plants. Considering all of the above, the introduction to the culture and reproduction of *Thuja* occidentalis is very relevant [10, 11]. The expediency of introducing new plants depends on the degree of rooting and the profitability of the application of phytohormones [12]. An important aspect of successful rooting of plants is the selection of planting dates. Already at the end of the XIX century and at the beginning of the XX century, R.I. Shreder and Z.S. Kurdiani wrote the first recommendations on the dates and methods of propagation by softwood-cuttings of deciduous and coniferous plants. An important factor affecting the effectiveness of root formation is the selection of auxins and their concentrations. Obtaining the maximum number of rooted cuttings at minimal cost is the main indicator of the correct choice of phytohormone and its concentration. The profitability of rooting decorative exotics by the vegetative method of propagation by softwood-cuttings using auxins is determined by the quantity and quality of the output material and costs at all stages of production [13-15]. The purpose of our research is to select the most effective auxins and their concentrations for the production of planting material with high profitability.

2 Materials and Methods

The objects of the study were plants of 5 forms of *Thuja occidentalis*, growing in the North American zone, from the genetic collection of the VNIISPK arboretum (Table 1). The work was carried out in 2014-2016 according to the generally accepted methodology of M.T. Tarasenko with the calculation of profitability of production [16]. The following auxins and their concentrations were chosen: 1) IBA (indole-buteric acid) 100 mg/l; 2) Heteroauxin 17 mg/l; 3) Control – water. The experiment was started in early June. Planting was carried out in greenhouses with airborne irrigation, the substrate consisted of sand and soil. The planting spacing was 7×5 cm. The experiment was laid down in three variants and two repetitions of 20 cuttings each. The cost of measures to prepare cuttings for planting amounted to 910.0 rubles per $1m^2$. The cost of selling rooted soft cuttings of *Thuja occidentalis* was 35 rubles. The cost differed depending on the auxin used and its concentration, from 5.5 rubles to 10.9 rubles.

Table 1. Objects of the studies.

Thuja occidentalis forms	Amount, pcs.	Year of planting
f. *columna*	10	1968
f. *globosum*	5	1968
f. *umbraculifera*	4	1968
f. *filiformis*	5	1973
f. *Ellwangeriana aurea*	11	1968

3 Results and Discussion

When assessing the quality of the obtained cuttings, the appearance and size of the root system were evaluated. A high percentage of rooting was observed when treated with a IBA preparation at a concentration of 100 mg/l for all *Thuja occidentalis* forms. When assessing the root system of rooted cuttings, a high degree of development was observed in *Thuja occidentalis f. filiformis* when treated with a growth stimulant "Heteroauxin" at a

concentration of 17 mg/l and in *Thuja occidentalis f. columna* with a growth stimulant " IBA " at a concentration of 100 mg/l (Table 2).

Table 2. Objects of the studies

№	Species			Heteroauxin 17mg/l		IBA 100mg/l		Control (water)	
				Rooted, %	V*, score	Rooted, %	V*, score	Rooted ,%	V*, Score
1	*Thuja occidentalis*	f. *columna*	average	30	3	60	4	0	0
			1	28	3	55	4	0	0
			2	32	3	65	4	0	0
			3	30	3	60	4	0	0
2		f. *globosum*	average	35	3	45	3	0	0
			1	35	3	40	3	0	0
			2	30	3	50	3	0	0
			3	40	3	45	3	0	0
3		f. *umbraculifera*	average	30	3	43	3	0	0
			1	20	3	40	3	0	0
			2	40	3	43	3	0	0
			3	30	3	45	3	0	0
4		f. *filiformis*	average	40	4	55	3	0	0
			1	35	4	50	3	0	0
			2	45	4	55	3	0	0
			3	40	4	60	3	0	0
5		f. *Ellwangeriana aurea*	average	30	3	55	3	0	0
			1	20	3	55	3	0	0
			2	38	3	55	3	0	0
			3	32	3	55	3	0	0
$LSD_{0,5} = 3,13$									

*V – Root system volume

Treatment of *Thuja occidentalis* with auxin IBA 100 mg/l proved to be the most effective compared to Heteroauxin 17 mg/l. In the control variant, rooting was not observed. The net profit per 1 m^2 when using phytohormones IBA 100 mg/l was from 3336.9 rubles to 4946.9 rubles (Fig. 1.), and when using Heteroauxin 17 mg / l, the profit was from 2017.2 rubles to 2997.2 rubles (Fig. 2.). Based on the obtained data, when using auxins for rooting soft cuttings of *Thuja occidentalis*, the highest profitability indicator was observed when treating with IBA 100 mg/l.

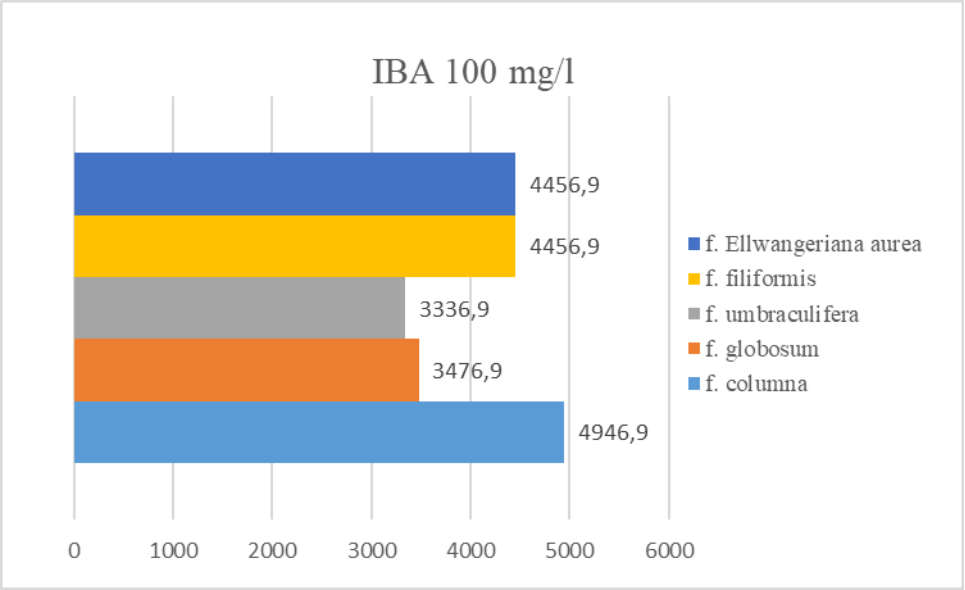

Fig. 1. Net income from the production of rooted cuttings treated with IBA - 100 mg/l.

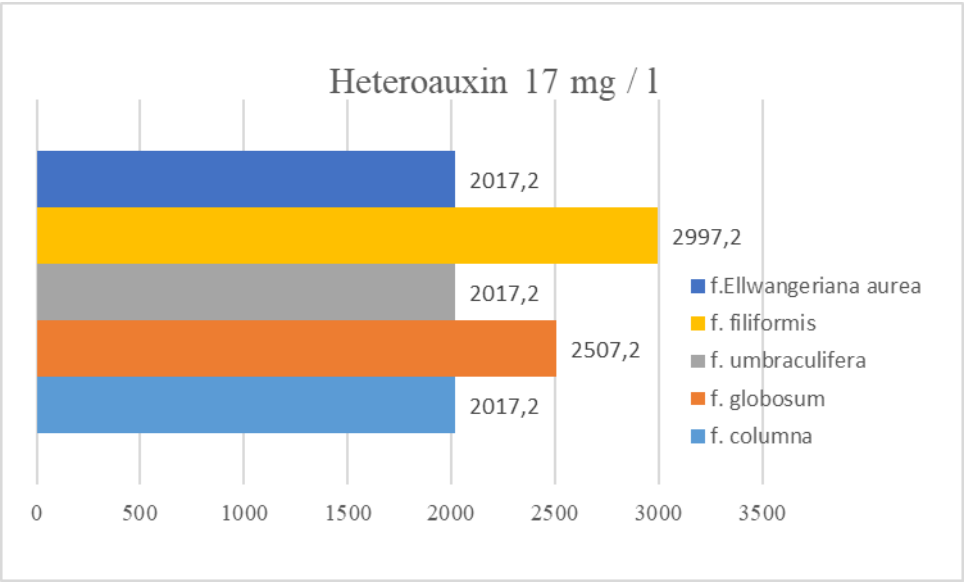

Fig. 2. Net income from the production of rooted cuttings treated with Heteroauxin.

4 Conclusion

As a result of our research on the reproduction of *Thuja* plants, when treated with auxins, the phytohormone IBA 100 mg/l was preferred. The use of this root formation stimulator makes it possible to get the highest yield of planting material at a high level of profitability and can be recommended for production. In the control variant, rooting was not observed.

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