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Research Article

EFFECT OF GROWTH REGULATORS ON SELECTED MORPHOLOGICAL FEATURES OF YELLOW PINE

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ABSTRACT

The aim of study was to compare the effects of two growth regulators on selected morphological features of yellow pine. In April 2012, 9 plants of yellow pine Lawson variety were planted to the soil. In April 15, 2013 a research agent in a form of following growth regulators: Asahi SL and Moddus 250-EC was introduced. There were the following experimental objects: C – control (only water spraying), As – Asahi spraying, Md – Moddus spraying. The tested features were: increase in plant height (cm), the increase in needle length (cm) of yellow pine. Measurements of increases in length of needles were made in each case on the same specially marked parts of the plants and performed on 27th of each month from beginning of May to ending of September. Among the used of growth regulators the greatest influence on the height increase of the tested trees as well as on the needle length of yellow pine more affected regulator Moddus. The largest total increase in the needles length of yellow pine was on the object with Modus and Asahi, and on control object it was significantly lower than on objects with growth regulators.

Keywords: biostymulants, Moddus 250-EC, Asahi SL, yellow pine.

INTRODUCTION

Stimulators are commonly referred to as biostimulants [Smoleń and Szura, 2008]. According to Jankowski and Dubis [2008] biostimulators are biologically active substances in its composition containing hormones, enzymes, proteins, amino acids, trace elements and other compounds which are typically used in small doses, activate metabolism, mainly in the direction of growth and development of the whole plant. Their main task is to participate in the regulation of life processes at a cellular level, organ and whole organism. Effect of bio-stimulators for plants does not result from direct participation in the regulation of life processes, but from the impact on the metabolism in a broad sense. They stimulate the synthesis of natural hormones, sometimes increase their activity, improve the intake of minerals from the ground and induce root growth.

According to Przybysz et al. [2010] first preparation stimulates of plant growth and development introduced widely into orchard practice was Asahi SL.

In Poland intensive research [Kozak et al. 2008] has been conducted for a few years on the mechanism of interaction of biostimulator Asahi SL on growth, development and yield of field crops, vegetables and fruits.

Another growth regulator is Moddus 250-EC, whose active ingredient is trinexapac ethyle – 250 g/l (25.5%). This preparation has been studied practically only in crops, such as winter and spring wheat, spring and winter barley, rye, winter triticale and oat [Gruszczyk and Berbeć 2004; Michalski et al. 2008; Kozak et al. 2008; Budzyński et al. 200:, Malarz et al. 2008], grown in intensive technologies with high levels of nitrogen fertilization on grasses lawn [Jankowski et al. 2012; Czeluścinski et al.2008]. In the literature, there is very little data on the effects of growth regulators on ornamental trees. If they are connected with leafy trees [Adamiak and Hetman 2007; Bąbelewski and Dębicz 2006; Górnik

and Grzesik 2005; Hetman and Adamiak 2003 b] there is no such data in relation to conifers.

Therefore, the aim of the study was to compare the effects of these two growth regulators on selected morphological features of yellow pine.

MATERIALS AND METHODS

The experiment was established at forest school area in Ceranów. In April 12, 2012 9 plants of yellow pine (Pinus ponderosa Dougl. Ex C.) Lawson variety were planted to the soil (soil quality class 5). In first year the plants were only cultivated and infested between rows. In April 15, 2013 a research agent in the form of following growth regulators was introduced: Asahi SL and Moddus 250-EC, at a dose of 100 ml of preparate in 100 l of water.

There were the following experimental objects: C – control (only water spraying), As – Asahi spraying, Md – Moddus spraying. The tested features were: increase in plant height (cm), increase in needle length (cm) of yellow pine. Measurements of increases in length of needles were made in each case on the same specially marked parts of the plants and performed on 27th of each month from beginning of May to the end of September.

The results were evaluated statistically by performing variance analysis. Medium differentiation was verified by Tukey's test at a significance level of $p \leq 0.05$.

Meteorological data for the study area were obtained from the Hydrological and Meteorological Station in Siedlce. However, in order to determine the temporal variability of meteorological elements and their influence on plant growth, the hydrothermal coefficient of Sielianinov was evaluated.

From the data presented in Table 1 resulted that the most favourable distribution and magnitude of rainfall, with optimal air temperatures in the period of plants growing were in May and September. For those months the highest values of coefficient (K>2), were recorded which indicates the optimal relation to the value of the air temperature and precipitation. It should also be noted that in August was aqueous deficit what was transformed into strong drought (K = 0.25).

RESULTS AND DISCUSSION

Increase of pine height (Figure 1) was varied and depend both on the applied biopreparation and the month in which this measurement was made. In regard to the nature of used in the research of growth substance, it was found that the largest increases in pine height (19 cm) was obtained in June, as a result of Asahi formulation. In the successive months of research until September a systematic decrease in the height growth of trees was observed. It is worth noting that in all the months higher increases in plant height were obtained for objects with regulators than for the control object. This relationship has also been confirmed in the assessment of total growth of yellow pine (Figure 2). The highest total growth was achieved on the object with Moddus (42.1 cm) and only slightly less on the object with Asahi (41.0 cm). The differences between these objects were not statistically significant. The total regrowth of yellow pine from objects with regulators differed significantly in compare to the control object (31.0 cm).

These results are confirmed in Hetman and Adamiak [2003 a,b] studies, where the treatment of plants for root-stock with Asahi SL and Titanite preparations had a positive impact on their quality .

Another estimated parameter was the increase in the length of the needles (Table 2). These studies showed different response of needle length to the applied of growth regulators. The largest increase in the needle length was achieved in May after applying of Moddus preparation (1.10 cm). A slightly smaller increase reached the needles after application of Asahi (0.80 cm). The differences between these objects were not significant statistically. In turn, on the control object the increase of the needles length was the lowest (0.30) and differed significantly to the other objects. Also in Bąbelewski [2008] studies was found beneficial effects, eg in the production of bicolor acidantara var Murielska and root-stocks of rose multiflorum [Kocira, Laskowska 2005].

Table 1. The value of hydrothermic coefficient of Sielianinov (K) in each month of the growing season

Year	Month						
	IV	V	VI	VII	VIII	IX	X
2013	1.60	2.20	1.80	1.50	0.25	2.70	1.22
K<0.5 – strong drought; 0.51–0.69 – drought; 0.70–0.99 – poor drought; K> 1 – no drought							

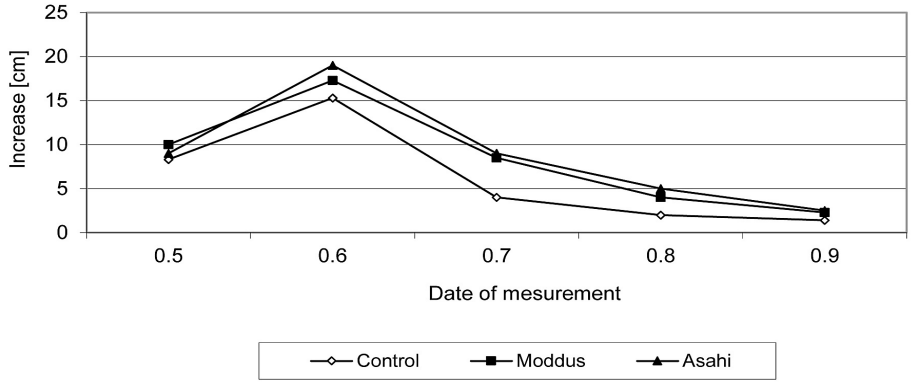

Figure 1. Increase in the height of yellow pine in particular time measurement terms depending on growth regulator

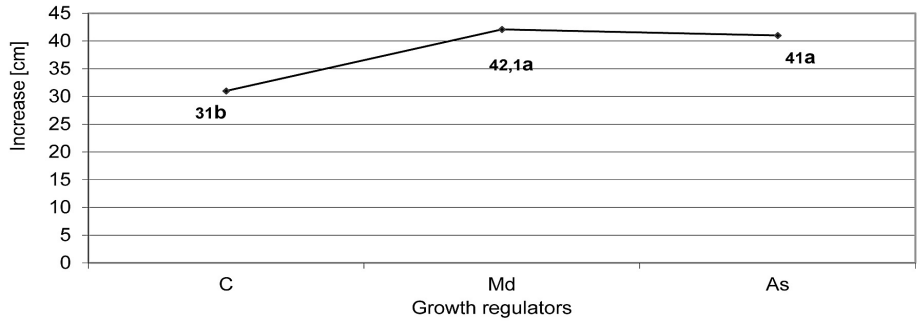

Figure 2. Annual growth in the height of yellow pine, depending on the growth regulator

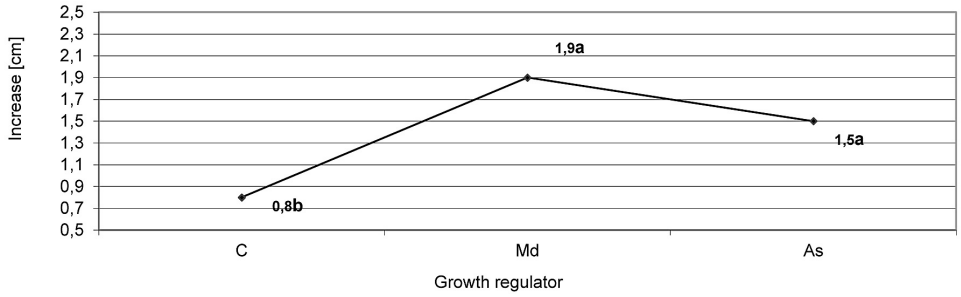

Figure 3. The total increase in the needles length of yellow pine, depending on the growth regulator

Table 2. Increase in the needle length of yellow pine in particular measurement terms depending on growth regulator

Regulator	Date of masarement (month)					Mean
	0.5	0.6	0.7	0.8	0.9	
C	0.30^{Ba}	0.10^{Bb}	0.20^{Bab}	0.10^{Ab}	0.10^{Ab}	0.16^{B}
Md	1.10^{Aa}	0.20^{Ab}	0.40^{Aab}	0.10^{Ab}	0.10^{Ab}	0.38^{A}
As	0.80^{Aa}	0.20^{Ab}	0.30^{ABb}	0.10^{Ab}	0.10^{Ab}	0.30^{A}
Mean	0.73^{a}	0.16^{b}	0.30^{b}	0.10^{b}	0.10^{b}	–
Mean in columns estimated with the same big litters don't differ significantly Mean in lines estimated with the same small letters don't differ significantly						

Asahi SL at concentrations of 0,1% to 0,6% increased the diameter and length of the root colour and the above ground dry matter and the root system [Hetman and Adamiak 2003 b]. These studies showed that to July the effects of growth regulators applied were visible, in the form of different length needles increments. However, in August and September the increase of needle length was 0.10 cm and did not differ between the objects.

The effect of applied growth regulators can be seen in the assessment of the total increase in the needles length of yellow pine (Figure 3) in rela-

tion to the growing season (May - September). The largest total increase in the length of needles were obtained on the object with Moddus (1.9 cm) and slightly less on the object with Asahi (1.5 cm). The differences between these objects were not significant statistically. Significantly smaller increase reached the needles on the control object (0.8 cm).

In a study conducted by Hetman and Adamiak [2005] was found that in the rose bushes treated with Asahi SL preparation was obtained from 7 to 12% more shoots of first row than in the control shrubs. Foliar application of preparations with properties stimulating growth and development is a fast way to stimulate plants for proper growth and development.

CONCLUSIONS

1. Among the used growth regulators the greatest influence on the increase height of the tested trees as well as on the needle length of yellow pine were more affected by Moddus regulator.
2. From the vegetable period the largest increase of yellow pine was recorded in June.
3. The largest total increase in the needles length of yellow pine was recorded for the object with Moddus and Asahi, and on control object was significantly lower than on the objects with growth regulators.

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