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THE INFLUENCE OF SOME GROWTH REGULATORS ON THE GERMINABILITY AND DEVELOPMENT AT *ALBIZIA JULIBRISSIN* DURAZZ.

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Abstract

Among the multitude of dendrological species with high decorative value, Albizia genus is of particular importance in the landscape design especially in the conditions of our country which are generally favorable and very favorable for the growth of these species. The purpose of the present work is to highlight the ornamental potential of the best known species of Albizia genus. Albizia julibrissin Durazz. *seeds were used for the experiment. Propagation of this species can be done quite easily by seeds, provided that the pods are harvested in October and the sowing is done in the spring (Sandu, 2009). Observations were made regarding the evolution in different periods of the vegetation, aiming the development regarding the germinability, growth and development of seedlings under the action of some rooting regulators, namely Radi-Stim Nr. 2, Asfac-4 25 ppm and Asfac-4 20 ppm. The variants treated with these regulators had a particular importance on seed germination, in terms of a deeper rooting, resulting in much more vigorous plants.*

Key words*: seedlings, variants, growth regulators, Albizia, germinability.*

INTRODUCTION

One of the basic components of the green spaces that ensure the aesthetic appearance of the localities is the landscaping. Among the multitude of dendrological species of ornamental trees, the species of the genus *Albizia* are of particular importance in the arrangement of green spaces and the conditions in our country are generally favourable and very favourable for this specie.

Albizia julibrissin Durazz. is a tree that reaches 12 m heights. It is characterized by a showy crown, slightly branched, with divergent branches (Sandu, 2009). It has bipinnate leaves with up to 12 leaflets. The flowers are pink, grouped in spherical heads (Mohan et al., 2010) and forms 12-13 cm long flat pods, light brown in colour (Iliescu, 2002).

The need to diversify the assortment is imposed as a priority considering the diversity of the biological material and above all the achievements reached worldwide.

Plant propagation sector registered technical innovations (automatic mist propagation unit, basal heating) that provide optimal environmental condition to improve rooting efficiency (Ferrante et al., 2013).

Despite of the optimal environment cuttings are exposed to various stress factors during rooting due to the lack of roots and root functions.

Rooting and growth regulators are generally used in plant production to improve mineral intake efficiency, enhance plant resistance and tolerance to abiotic and biotic stress and also stimulate some physiological processes related to development (Cojocariu et al., 2019; Filiti et al., 1986; Petrozza et al., 2013).

This work complements the researches in the field, as an effective and well-documented material because it tracks seed germination, the rooting percentage and the development of *Albizia julibrissin* plants under the action of two growth regulators. Propagation of this species can be done quite easily by seeds. Pods are harvested in october and the sowing of the

seeds is done in the spring. (Szabóet al., 2013; Zaharia et al., 2003).

MATERIALS AND METHODS

The aim of our research was testing the effect of growth regulators on *Albizia julibrissin* Durazz. seed germination process.
In our study, namely Radi-Stim powder, Asfac-4 25 ppm and Asfac-4 20 ppm regulators were tested in dendrological crops such as *Albizia* to speed up growth reducing the nursery.
The experimental design is the following:
- Seeds treated with **Radi-Stim powder**: treated variant (Vt) and a control variant (Vc);
- Seeds treated with **Asfac-4 variant**: treated variants (V1, V2) and a control variant (Vc).

1. Radi-Stim powder variant

For this variant seeds were powdered with Radi-Stim powder and then sown on 28.02.2022.
100 seeds were used, placed in alveolar pallets divided as follows:
- 50 seeds were treated with Radi-Stim powder (treated variant).
-50 untreated seeds (control) on a substrate with pH between 7-7.5.
By the time the seed germinate, watering was done at least four times a week.

2. Asfac-4 variant

For Asfac-4 variant seeds were sown on 14.04.2022.
- 50 seeds-treated with Asfac-4, 20 ppm, immersed for 4 hours in the solution;
- 50 untreated seeds (control) watered for one hour;
- 50 seeds treated with Asfac-4, 25 ppm, immersed for 4 hours in the solution.
Sowing was carried out after immersion in the solution, in the alveolar pallet in a substrate with a pH-u1 of 6.5-7.

Phytosanitary treatments

Due to the different conditions during the sowing period, the experimental variants required different treatments with phytosanitary substances:
- for **Radi-Stim** variants were performed only 3 treatments for *Trialeurodes vaporariorum*, using Actara 25 WG 0.02%.
- for **Asfac-4** variants were required treatments for both *Trialeurodes vaporariorum* using Actara 25 WG 0.02% (3 treatments), and against *Pythium debaryanum* using Previcur 607 SL 0.15% (3 treatments).
Observations regarding the emergence and growth of *Albizia julibrissin* Durazz seedlings were carried out daily, the measurements being recorded weekly.
Data statistical processing was carried out based on variance analysis (limit differences, DL test) (Săulescu N.A., Săulescu N.N., 1967).

RESULTS AND DISCUSSIONS

Results for Radi-Stim variants

Seed germination took place on 07.03.2022, the percentage of germination being higher in the case of the treated variant than in the control one. Until the first measurement, the sprouted plants evolved in growth, some sprouted on 12.03.2022, the percentage of sprouting being 65% for the treated variant (Figure 1A) and 35% for the control (Figure 1B).
Table 1 presents plants growth between 13.03.2022 until 03.04.2022 and it can be observed the very significant growth of treated variant compared to the control.

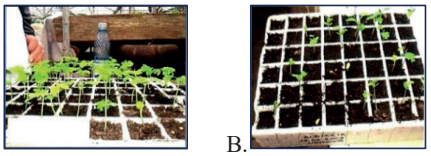

Figure 1.1st stage of plant growth,
Radi-Stim variant:
A - Treated variant B - Control (untreated)

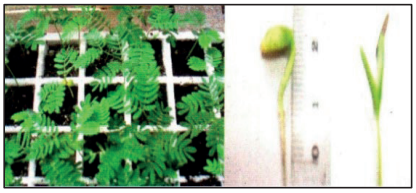

Figure 2. Cotyledon leaves stage

Figure 3. Experimental variants - 3rd stage of vegetation

Albizia plants have developed according to their stage, a part of them show the second layer of leaves, and the plants that have just emerged have obvious cotyledonal leaves (Figure 2).
As the plants grew, the cotyledon leaves began to disappear, entering the 3rd stage of vegetation (Figure 3). The emergence percentage was 79%.

Table 1. Results on plants growth, Radi-Stim variant at different date observation, data for year 2022

Variant	Observation time/ plants growth (cm)	
	13.03.2022	
	Average	DL 5% = 0.71
Vt	2.83***	DL 1% = 1.12
Vc	0.63	DL 0.1%= 1.78
Variant	20.03.2022	
	Average	DL 5% = 0.84
Vt	3.00***	DL 1% = 1.21
Vc	0.91	DL 0.1% = 1.87
Variant	27.03.2022	
	Average	DL 5% = 0,72
Vt	3.22***	DL 1% = 1.00
Vc	1.11	DL 0.1% = 1.63
Variant	03.04.2022	
	Average	DL 5% = 0.61
Vt	3.65***	DL 1% = 1.05
Vc	2.07	DL 0.1% = 1.57

Vt-Variant treated with Radi-Stim powder;
Vc- control untreated.

On 07.04. and 08.04 2022 *Albizia* plants were transplanted.
On 04.07.2022, at the treated variant followed a second transplantation because the germination percentage was 100%. The plants were vigorous, different in color and with a very well defined root system.
On 04/08/2022, the control variant was also transplanted, germination percentage being of 85%. The plants were smaller, less vigorous, differently colored and the root system well developed. The same type of substrate with pH 7.5 was used as in case of sowing. After transplantation plants were watered. The growth of the plants after transplanting recorded the average values registered in Table 2 and Figure 4.

Figure 4. *Albizia julibrissin* first transplantation

From 16.04.2022 the plants went through a period of cold so that the growths were no longer so obvious but the low temperature interval served as tempering (Table 2).
After the second transplantation (Figure 5) which is stimulated with Radi-Stim, the plants grow, the stem is obvious, starting to lignify, they are very tall.
Due to the fact that they have very fast growth and a much branched root system, plants require a new transplantation.

Figure 5. Plants second transplantation

Table 2. Results on plants growth after transplantation, Radi-Stim variant at different date observation, data for year 2022

Variant	Observation time/plants growth (cm)	
	16.04.2022	
	Average	DL 5% = 0.61
Vt	1.35*	DL 1% = 0.93
Vc	0.83	DL 0.1% = 1.72
Variant	05.05.2022	
	Average	DL 5% = 0.54
Vt	1.73*	DL 1% = 0.81
Vc	1.06	DL 0.1% = 1.67
Variant	16.05.2022	
	Average	DL 5% = 0.87
Vt	2.75*	DL 1% = 1.35
Vc	1.35	DL 0.1% = 2.54
Variant	26.05.2022	
	Average	DL 5% = 0.76
Vt	3.07*	DL 1% = 1.14
Vc	2.06	DL 0.1% = 2.11
Variant	06.06.2022	
	Average	DL 5% = 0.74
Vt	3.5*	DL 1% = 1.15
Vc	2.71	DL 0.1% = 2.19
Variant	26.06.2022	
	Average	DL 5% = 0.83
Vt	3.73	DL 1% = 1.37
Vc	3.01	DL 0.1% =2.54
Variant	26.07.2022	
	Average	DL 5% = 1.04
Vt	4.01	DL 1% = 1.66
Vc	3.37	DL 0.1% = 3.11
Variant	16.08.2022	
	Average	DL 5% = 1.06
Vt	4.39	DL 1% = 1.65
Vc	3.75	DL 0.1% = 3.14
Variant	02.09.2022	
	Average	DL 5% = 0.93
Vt	4.93	DL 1% = 1.57
Vc	3.99	DL 0.1% = 2.98
Variant	21.09.2022	
	Average	DL 5% = 0.82;
Vt	5.52*	DL 1% = 1.35;
Vc	4.64	DL 0.1% = 2.47
Variant	01.10.2022	
	Average	DL 5% = 0.97;
Vt	5.88*	DL 1% = 1.54;

Vc	4.88	DL 0.1% = 2.76
Variant	**21.10.2022**	
	Average	DL 5% = 0.91 DL 1% = 1.58 DL 0.1% = 2.83
Vt	6.06*	
Vc	4.96	

Vt - variant treated with Radi-Stim powder;
Vc - control untreated.

At the measurements from 06.06.2022, the plants registered significant growth, watering was reduced and treatments for *Trialeurodes vaporariorum* were applied.

In the following interval, the plants grew and developed according to the phenophase of vegetation. Until the end of the vegetation period, some specimens reached a height of 12-13 cm high and others remained in the same vegetation stage due to the temperature differences between night and day.

The losses during the winter were around 20% in Radi-Stim variant (Table 3, Figure 6).

Table 3. Results on plants growth Radi-Stim variant, data for year 2023

Variant	**Observation time/ plants growth (cm)**	
	03.04.2023	
	Average	DL 5% = 0.88 DL 1% = 1.26 DL 0.1% = 2.35
Vt	6.37*	
Vc	5.40	
Variant	**18.04.2023**	
	Average	DL 5% = 0.81 DL 1% = 1.45 DL 0.1% = 2.68
Vt	6.84*	
Vc	5.80	

Vt - variant treated with Radi-Stim powder;
Vc - control untreated.

Figure 6. Plants growth, Radi-Stim variant, second year of vegetation

Results for Asfac-4 variants

On 29.04.2022, the first plants from the alveolar pallet began to sprout, the seeds being treated with Asfac-4 in 2 concentration variants (20 and 25 ppm).

Transplanted plants continued their growth and, in some cases, due to the lower temperatures in the greenhouse at night, part of the leaves began to dry (Figure 7 and 8). At this point, treatments for *Trialeurodes* were carried out. The observations regarding plants growth from May to June are recorded in Table 4.

V1 - 20 ppm V2 - 25 ppm

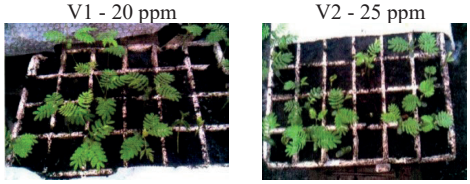

Figure 7. Plants emergence, Asfac-4 variant

Figure 8. Plants growth -control -untreated

Table 4. Results on plants growth at the variant treated withAsfac-4, data for 2022

Variant	**Observation time/ plants growth(cm)**	
	5.05.2022	
	Average	
V1	0.22	DL 5% = 0.27 DL 1% = 0.39 DL 0.1% = 0.51
V2	0.45*	
Vc	1.15	
Variant	**16.05.2022**	
	Average	DL 5% = 0.43 DL 1% = 0.58 DL 0.1% = 0.95
Vl	1.05*	
V2	0.96*	
Vc	0.59	
Variant	**26.05.2022**	
	Average	DL 5% = 0.51 DL 1% = 0.74 DL 0.1% = 1.23
Vl	1.47*	
V2	1.40*	
Vc	0.82	
Variant	**26.06.2022**	
	Average	DL 5% = 0.36 DL 1% = 0.48 DL 0.1% = 0.74
V1	2.67***	
V2	2.34**	
Vc	1.72	

V1- variant treated with Asfac-4 20 ppm;
V2- variant treated withAsfac-4 25 ppm;
Vc- control untreated.

In the control variant, 6 plants were removed because they withered, being necessary to eliminate them from experiment and 4 were eliminated from the treated variant.

On 23.05.2022 a treatment was carried out for *Pythium*.

Also in variant treated with Asfac-4 the plants grew (Figure 9), those that sprouted entered 2nd stage of development, the color of the leaves is

different from light green at the time of growth to a dark green with obviously colored edges and veins in carmine red. The emergence percentage oscillates reaching at the moment 80% in the variant treated with Asfac-4 25 ppm, 65% in the variant treated with Asfac-4 20 ppm and only 40% in the control variant.

Figure 9. Sown variant treated with Asfac-4, 2nd stage of vegetation

From 26.05. the plants developed further, in those where Asfac-4 was used, some entered the 3rd stage of vegetation. At this stage, leaves on the edge and the main vein are colored carmine red which is characteristic of the specie.
The treatment for *Pythium* did not give much results because they were lost around 15 seedlings out of their total, and the ones that are just emerging are also affected (Figure 10).

Figure 10. Plants treated with Asfac-4, 3rd stage of vegetation

From 26.06.2022 the plants grew, and those from the transplanted version were transplanted again on 12.07. in much larger pots because the root system could no longer develop normally, needing more space. The substrate has a pH between 6.5-7 (Figure 11).
It followed a second transplanting on 12.07.2022 at treated version and on 13.07.2022 at the control version.
On 27.07.2022, for all variants, were carried out phytosanitary treatments, removal of weeds, dry leaves and soil loosening.

Figure 11. Plants after transplantation - Asfac-4 variant

From 16.08.2022 the plants registered new growth (Table 5), in both variants, treated with Asfac-4, 20 ppm and 25 ppm. Then, plants were taken out of the greenhouse to adjust to the temperature fluctuations during the summer.

Table 5. Results on plants growth at the variant treated with Asfac-4, after transplantation, data for 2022

Variant	Observation time/ plants growth(cm)	
	26.07.2022	
	Average	
V1	0.35	DL 5% = 0.25 DL 1% = 0.57 DL 0.1% = 2.62
V2	0.30	
Vc	0.25	
Variant	**16.08.2022**	
	Average	
V1	0.81	DL 5% = 0.43 DL 1% = 1.07 DL 0.1% = 3.24
V2	1.30	
Vc	0.45	
Variant	**02.09.2022**	
	Average	
V1	1.35**	DL 5% = 0.23 DL 1% = 0.46 DL 0.1% = 1.31
V2	1.05*	
Vc	0.80	
Variant	**21.09.2022**	
	Average	
V1	2.23**	DL 5% = 0.48 DL 1% = 0.93 DL 0.1% = 2.87
V2	1.57*	
Vc	1.10	
Variant	**01.10.2022**	
	Average	
V1	2.40*	DL 5% = 0.50 DL 1% = 1.14 DL 0.1% = 3.49
V2	1.90	
Vc	1.45	
Variant	**21.10.2022**	
	Average	
V1	2.85*	DL 5% = 0.61 DL 1% = 1.40 DL 0.1% = 4.57
V2	2.05	
Vc	2.50	

V1-variant treated with Asfac-4 20 ppm;
V2- vatiant treated with Asfac-4 25 ppm;
Vc- control untreated.

Subjection to climatic factors is a very good thing because they have behaved very well, the root system is well developed, the color of the plants is different, oscillating from dark green to light green when another layer of leaves grows, having the edge leaves colored with carmine red.
Since 02.09.2022, the plants have been treated again for *Pythium* and care works consisting of weeding, breaking the crust, loosening the soil.
Growth is slower in the plants that have been transplanted twice, a sign that the seedlings are gradually preparing for winter, while in the part stimulated with Asfac-4 they continue to grow, taking the plants outside only on warmer days to avoid plant breakage caused by wind and rain.
Significant and distinct significant diferences can be seen in case of 20 ppm variant.

Since 21.09.2022 the plants have undergone some changes, the growth being very small.
Since 01.10.2022 there have been no further changes, the growth is no longer visible, growing only by 5 mm in some plants. Being a deciduous tree, it prepares to enter the period of vegetative rest, stopping all processes of growth and development.
The plants were brought indoors to prevent the wind from destroying the plants.
Throughout the resting period, the plants were watered, kept at the optimal temperature to avoid frost, as they are sensitive to low temperatures.
On 15.03.2023 the plants started to grow, a sign that they resumed their vegetative stage.
Losses over the winter were around 15% in the variant stimulated with Asfac-4.

Table 6. Results on plants growth at the variant treated with Asfac-4, year 2023

Variant	Observation time/ plants growth (cm)	
	03.04.2023	
	Average	
V1	2.92**	DL 5% = 0.33 DL 1% = 0.74 DL 0.1% = 2.37
V2	2.25*	
Vc	1.65	
Variant	18.04.2023	
	Average	
V1	3.70**	DL 5% = 0.65 DL 1% = 1.41 DL 0.1% = 4.58
V2	2.90*	
Vc	2.20	

V1- variant treated withAsfac-4 -20 ppm;
V2- variant treated with Asfac-4 25ppm;
Vc- control untreated.

Both variants, Radi-Stim and Asfac-4 resumed their vegetation cycle, the differences between them being a few days.
The plants started to grow even more and colored light green in the variant treated with Radi-Stim and dark green in the variant treated with Asfac-4.
The growth is more obvious in Radi-Stim variant than in the variant treated with Asfac-4. Plants had increased resistance to diseases and pests, have a well-developed root system. The plants high reached up to 27 cm.
Since 03.04.2023 the plants have recovered, they have grown (Table 6), watering was done more and more and also care work has been carried out which consists of: removing dry plants, weeding the weeds, breaking the crust, filling the pots with soil, aerating the root system.

Discussions

Seed germination occurred 8 days after sowing, most of them from the variant treated with Radi-Stim powder. However, most of the seedlings emerged around 12.03.2022, the results being obviously favorable for the variant treated with Radi-Stim powder compared to the control version, namely: 67.5% for the treated variant, compared to 31.25% for the control, untreated.
During the observations, obvious differences were noted between the two variants regarding the speed and percentage of germination, the variant treated with Radi-Stim powder being superior to the control by 5-25%.
Treatments using rooting regulators favoured seed germination, plant emergence and positively influenced the germination percentage, duration and speed of emergence also in case of other reserches using perenials (Cojocariu, 2019; Ferrante, 2013).
Figure 12 shows the growth evolution from the moment the seed germinates until transplanting; the measurement values match the interval March 13 till April 3, 2022.
The plants were transplanted on 7 and 8 of April, 2022, for the variant treated with Radi-Stim powder, with a 100% planting success.
Figure 13 shows the evolution of plant growth from replanting until plants went dormant, the measured values corresponding to the interval April 16 - October 21, 2022.

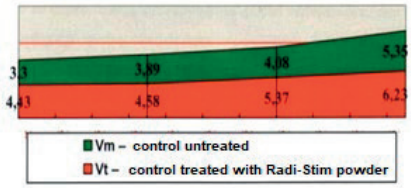

Figure 12. Growth evolution from the moment the treated seeds germinate until transplanting, Radi Stim variant

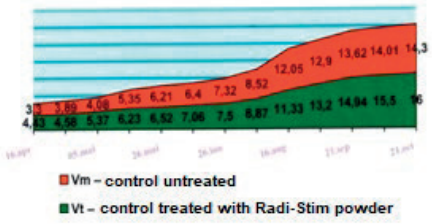

Figure 13. Evolution of plant growth from replanting until plants went dormant, Radi Stim variant

On 14.04.2022, the second experience was set, in order to compare the behavior with a germination stimulator from another category of active substances. For this, Asfac-4 was used, a growth stimulator with a phenoxyacetic nucleus substituted with sulfonamide groups, which is tested and approved on otherspecies and varieties (Petrozza, 2013; Szabó, 2013).

At this experiment (Asfac-4) the first seedlings emerged on 29.04.2022, but still with a delay of approx. 7 days compared to Radi Stim experiment.

Partial results so far highlight the fact that the sowing in the 3 variants was directly influenced by the environmental conditions but also by the lateness of the sowing time.

The observations made between 05.05 - 26.05 2022 highlighted the following aspects:

- germination was lower, varying between 50 and 78%, compared to the version treated with Radi-Stim where this percentage was 100%;
- the growth recorded in the sprouted seedlings had a lower rate, after approx. 3 weeks the plants having the average dimensions between 5 and 5.5 cm, while in the first experience, in the same time interval, the growths measured were, on average, 5.5-6.5 cm.

There where made observations of plants rooted after being treated with Asfac -4. Figure 14 highlights the growth evolution of these plants from germination until the time of transplanting, between 05.05. and 12.07.2022.

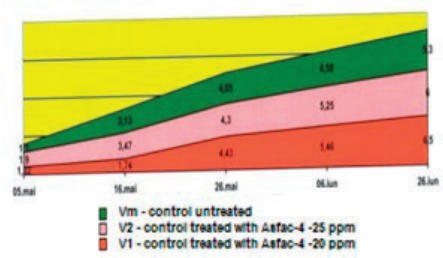

Figure 14. Plants growth evolution from germination until transplanting - Asfac-4 variant

Figure 15 shows the evolution of plant growth from transplanting until they went dormant. The measured values are included in the interval July 10 - October 21, 2022.

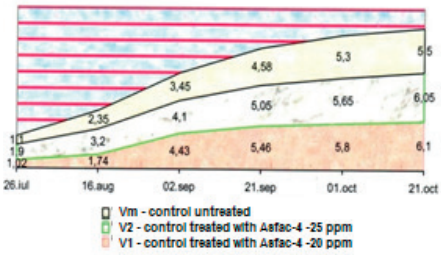

Figure 15. Plants growth evolution until dormancy, Asfac-4 variant

CONCLUSIONS

According to the observations made and the results on the evolution of growth stimulants used in *Albizia julibrissin*, it can be concluded that variants treated with growth regulators had a special importance on seed germination, formation of a deep root system and much more vigorous plants.

Seedling emergence occurred earlier (after approx. 8 days from sowing) in the case of the Radi-Stim powder treatment, the germination percentage varying between 67.5% and 100%.

Significant positive influence of the Radi-Stim product was noted only on the seeds germination percentage. Plants growth recorded during the observation interval 13 March 2022-18 April 2023 are based on the advantage that treated variants develop a more branched and healthier root system. The most obvious differences are noted at the level of the root system, where the plants from the variant treated with Radi-Stim showed obviously larger and richly branched roots.

In the case of the second variant, soaking the seeds in Asfac-4 solutions, it was highlighted that the germination was lower than in the case of seeds treatment with Radi-Stim, a fact that was also influenced by the less favourable environmental conditions during the experimental period.

From the analysis of the results regarding how the species reacts when a growth regulator is used, it appears that the best variant is the variant treated with Radi-Stim powder, and in the case of using the Asfac-4 product, the best variant is V1 - the variant treated with 20 ppm.

In case of Radi-Stim treatment variant, a better percentage of plant emergenceswere recorded, explained by the fact that the optimal sowing time was respected, compared to Asfac-4 treatment variant, where sowing was carried out at the beginning of summer.

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