ULTRASOUNDS EFFECTS CONTRIBUTIONS ON THE NORWAY SPRUCE SEEDS GERMINATION (*Picea abies* (L.) Karsten)

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Abstract: For the reason that the Norway spruce seeds germination is weak (in some years the germination rate is less than 50%) we tried to improve it by seeds exposures to certain doses of ultrasound radiations. To notice that studies alike this on the Norway spruce seeds are in incipient phases and also important because in the forests from Suceava County the Norway spruce is prevalent.

INTRODUCTION

The biological effects of the ultrasounds are multiples and complex (Scheffel, Ştiucă, 1995). At the plants, the ultrasounds can provoke stimulations or destructions, depending on the nature of the plant, her development stage and the ultrasound's parameters (intensity, frequency, and irradiation's duration).

The performed experiments with various plant varieties seeds spotlighted the following favorable effects: decreasing of the germination's period with approximately 30%, the increasing of the vegetal mass, the increasing of the leaf's formation speed, the growing of more vigorous roots, the increase of the productive potential.

There were used ultrasounds with frequencies between 16 kHz and 1MHz, intensities between 0,5 and 2 W/cm^2 and durations of irradiation between 0,5 and 5 minutes. The optimal stimulation was obtained for the product between the optimal intensity and the optimal duration.

If the seeds are wet, the optimal exposure time will reduce with 60% approximately, comparing to the dry seeds.

The stimulating action of the ultrasounds on the germination is produced by some modifications of the cellulose membrane, modifications which promote the nutrient's transportation and to a better absorption of the useful compounds from the soil.

MATERIAL AND METHOD:

There were used Norway spruce seed (5,24 g/1000 seeds) harvested in 2003 from more biotypes of the Moldovita forest ward which was irradiated with ultrasounds, at two different frequencies (500kHz and 1MHz), with a piezoelectric generator of ultrasounds (Scheffel, Ştiucă, 1989), that generated an intensity of 1 W/cm^2. The irradiated seeds were wet in order to decrease the exposure time.

The groups of 50 seeds each were exposed to the following irradiation times: 3, 6, 9, 12, 15, 18, 20, 30, 40, 50 and 60 seconds.

The germination was carried out according to the valid standards (SR 1634: June 1999), in a CONVIRON 4030 – G30 growth chamber, at 21^{0}C, without pre-refrigeration, 95% humidity with a 12 hours day/night alternation. The irradiated seeds were sown in two replicates of 50 each, in Petri dishes on filter paper, humectated periodically with distilled water. A blank with bi-distilled water was also carried out. It was measured the germination (G) at 21 days, the length of the hypocotyls (L_H) and of the roots (L_R).

RESULTS

The experiments were fulfilled in order to establish the biological answer of the spruce seed under the influence of the irradiation; the results are presented in table 1. Because the seeds proceeds from more genotypes (from the same year and same location), it was found an appreciable dispersion of the values.

Table 1. Ultrasounds effects on Norway spruce seeds germination (average values)

Ultrasound's frequency	time (s)	Length of the roots(mm)		Medium length	Length of the hypocotyls(mm)		Medium length	Germination Seeds/replicate		Mg(%)
		r1	r2	Mr. (mm)	r1	r2	Mt (mm)	r1	r2	
500 kHz	3	4.58	5.33	4.95	15.16	12.27	13.71	19	16	35
	6	3.80	6.25	5.02	20.38	18.27	19.32	16	15	31
	9	7.07	8.34	7.70	20.43	24.04	22.23	14	13	27
	12	9.38	8.62	9.00	18.88	19.77	19.32	16	13	29

Ultrasound's frequency	time (s)	Length of the roots(mm)		Medium length	Length of the hypocotyls(mm)		Medium length	Germination Seeds/replicate		Mg(%)
		r1	r2	Mr. (mm)	r1	r2	Mt (mm)	r1	r2	
	15	7.87	4.98	6.42	14.00	10.35	12.17	15	19	34
	18	4.73	6.73	5.73	12.87	13.87	13.37	15	15	30
	20	32.84	33.37	33.10	31.16	33.08	32.12	23	26	49
	30	19.89	21.57	20.73	34.28	32.93	33.60	18	14	32
	40	28.58	22.21	25.39	33.10	31.95	32.52	30	25	55
	50	35.37	32.68	34.02	31.46	35.36	33.41	27	26	53
	60	33.28	32.81	33.04	39.23	37.24	38.23	31	30	61
0 kHz	B	26.15	24.56	25.35	36.98	35.67	36.33	24	22	46
	3	16.6	15.52	16.06	35.29	33.57	34.43	20	21	41
	6	11.38	15.08	13.23	20.62	22.44	21.53	23	25	48
	9	15.09	15.41	15.25	15.27	13	14.23	14	17	31
	12	15.68	18.08	16.88	28.14	27.46	27.8	22	23	45
	15	6.13	6.13	6.13	19.5	18.13	18.81	18	15	33
1 MHz	18	16	20.17	18.08	31.31	31.08	31.19	19	23	42
	20	23.46	21.77	22.61	37.24	35.29	36.26	21	24	45
	30	32.52	36.44	34.48	32.69	34.97	33.83	26	31	57
	40	34.32	30.29	32.3	33.78	40	36.89	22	24	46
	50	34.3	35.18	34.74	35	41.19	38.1	27	27	54
	60	35.18	32.65	33.91	37.35	35.18	36.26	27	31	58

Note: r1 – 1-st repetition; r2 – 2-nd repetition; B – blank;
Mr – average of the root's length from the two replicates;
Mt – average of the hypocotyl's length from the two replicates;
$Mg_{\%}$– average of the germination from the two replicates (in %).

DISCUSSIONS AND CONCLUSIONS

The analysis of the data from the table 1 offers a first conclusion that for an appreciable amount of values samples it can be established an increasing of the germination's values. The same is valuable for the other categories, especially the roots where the elongation was more obvious.

Under 30 seconds – exposure time – the results were inconclusive, often with inhibitive effects, especially for the frequency of 500 kHz.

We can also remark the direct correlation between the exposure time and the stimulating effect of the ultrasound irradiation, as a rule over 30 seconds exposure time. This tendency is independent of the ultrasound's frequency.

Because the obtained data are only preliminaries, we can affirm that the use of ultrasounds in the stimulation of the germination can be a useful instrument but only if the optimal parameters were established (frequency, intensity and exposure times).

Another tendency manifested during the experiments and that could have a practical value is the roots elongation; the ultrasounds have a bio-stimulator effect upon the caulinary system (Khan, 1980).

REFERENCES

1. Khan A. A., 1980. *The physiology and biochemistry of seed dormancy and germination*. Elsevier/North-Holland Publishing Company, Amsterdam – New York - Oxford
2. Scheffel M., Ştiucă P., 1989. *Dispozitive cu ultrasunete* (vol.2), Ed. Tehnică. Bucureşti
3. Scheffel M., Ştiucă P., 1995. *Dispozitive ultraaacustice şi optice* (vol.1), Ed. Tehnică. Bucureşti
4. The Romanian Institute for Standardization, 1999. *Seeds for sowing. Determination of the germination*. SR1634: june 1999

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