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Effect of ultrasound on germination and seedling growth of castor (*Ricinus communis* Linn.)

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Abstract

The performance of Ricinus communis *Linn. seeds treated with ultrasonic waves of 2 MHz was studied. There was a significant decrease (P>1) in percentage germination due to the treatment. The plumule growth was also inhibited. In spite of significant increase in length, radicles showed a peculiar feature of coiling due to ultrasound.*

Key words: Ultrasound, Seed germination, Plumule growth, Radical growth

Introduction

Priming involves pre-sowing treatment of seeds. Hydro priming, halo priming, osmopriming and thermo priming have been widely used to promote germination and improve the quality of seeds under stressed conditions or after ageing from a long period of storage. In contrary to the above priming agents, ultrasonic priming of seeds is easier to operate and secondly, a time saving process.

The ultrasonic waves of high frequency (2 to 10 MHz) have been found to affect the germination and growth of the seedlings in various plants. The ultrasonic waves have much higher energy than other audible waves so they also have heating effect. A lot of work has been done on the effect of ultrasonic waves on the animal materials and some unicellular algae but the reports regarding their effect on seeds are a very few.

The responses of algae and animal cells to ultrasonic waves are similar because of lack of intracellular spaces. The ultrasonic waves cause loss of turgor pressure in *Spirogyra* and *Nitella* because of emulsification of cell contents. The effect is perhaps through cavitations and subharmonic emission. Coagulation of protein and their accumulation in clumps in Hydrodictyon has been reprted.

Both promotion and inhibition of seed germination by ultrasonic's have been reported. The presence of necrotic areas in treated seeds of maize has been reported. The present piece of work was done to investigate the effect of ultrasonic waves on *Ricinus communis* seed germination and seedling growth.

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Materials and Methods

The seeds of castor (*Ricinus communis* Linn.) were chosen for the study because of their hard and impervious test. The unsoaked seeds were treated with 2 MHz. Ultrasonic waves with interferometer in water in a double – walled vessel at 25^0C for 15 minutes. The seeds were then plated in 4" Petri-plates between the blotting papers as suggested by ISTA. The plates were watered with glass distilled water on every third day. The seed germination and seedling growth were followed on 4^{th}, 6^{th}, 8^{th}, 10^{th}, 12^{th}, 16^{th} and 18^{th} day during March/April, 2007.

Result and Discussion

Germination Studies

The treated seeds showed a significant decrease (P>1) in germination on 4^{th} day. The difference was more than 10%. The germination in treated and control seeds increased gradually up to 14^{th} day of the treatment. The germination in treated seed increased up to 22% on 8^{th} day and reached the peak level of 37.3% on 14^{th} day whereas the control showed 65% germination (P=1%). Thus there was significant decrease in seed germination due to ultrasonic treatment (Table 1). The experiment was repeated and the similar results were obtained. This is in conformity to the results in unsoaked seeds of maize which developed necrotic areas and showed reduced percentage germination.

Table 1: Effect of ultrasound on germination and seedling growth of castor (*Ricinus communis* Linn.)

Days after treatment	Control	Treated	Value of 't'
	Seed Germination (%)		
4	26.0 ± 3.79	15.0 ± 2.51	4.550**
6	41.0 ± 2.08	18.3 ± 1.85	2.791*
8	50.3 ± 2.96	22.0 ± 3.05	4.220**
10	59.6 ± 4.37	26.6 ± 3.18	5.412**
12	62.0 ± 2.77	32.3 ± 3.98	4.812**
14	65.0 ± 2.51	37.3 ± 3.18	4.059**
16	65.0 ± 2.51	37.3 ± 3.18	4.059**
	Plumule length (cm)		
10	0.0	1.2	-
12	2.1 ± 0.44	1.6 ± 0.30	0.537^{NS}
14	3.8 ± 0.72	2.3 ± 0.44	0.849^{NS}
16	6.1 ± 1.16	3.2 ± 0.41	1.240^{NS}
18	6.6 ± 0.95	3.6 ± 0.31	1.005^{NS}
20	7.3 ± 1.48	4.2 ± 0.47	1.556^{NS}
	Redicle length (cm)		
10	3.8 ± 1.85	8.6 ± 1.89	2.649*
12	7.9 ± 1.83	10.9 ± 2.65	3.188*
14	9.6 ± 2.74	13.6 ± 2.22	3.533*
16	10.4 ± 2.12	15.2 ± 1.74	2.747*
18	12.4 ± 1.80	17.2 ± 2.50	3.088*
20	12.6 ± 3.11	17.5 ± 3.01	4.335**

Plumule Growth

The treatment showed inhibitory effects on the plumule growth. The plumule emerged out of the seed on 8th day of treatment. The plumule emerged out in 100% cases in treated seeds which shows that early emergence of plumule was recorded due to ultrasonic treatment. The plumule growth on 16th day showed remarkable improvement and the rate was much higher in control (6.1cm) than in the treated (3.2cm) seedlings (Table 1). This pace of growth was maintained upto 20th day with plumule lengths 7.3cm in the control and 4.2 cm in the treated ones. Reductions in the plumules were found non-significant.

Radicle Growth

The radicle growth showed an overall enhancement due to ultrasonic treatment of seeds. In the seedlings from treated seeds the radicle length was significantly higher (P>5) to that of the control at all the intervals of observation (Table 1). The rate of growth decreased in the control than in the treated seeds. There was peak level increase in the radicle length at 20th day in the control (12.6cm) as compared to 17.5 cm in the treated one (P>5).

Though the percentage germination decreased, yet the emergence of plumule in the treated germinated seeds was earlier than in control. This indicates that the treatment of ultrasonic weakens the testa and helps in emergence of radicle and simultaneously affects the seedling growth adversely so that its rate of growth was reduced. The reduction in the plumule growth and promotion in radicle length were observed in *Pisum sativum* and *Vicia faba*. The emergence of first leaf took place in the treated seedlings on 16th day in 50% cases. This was delayed upto 20th day in untreated ones though linear growth of plumule was much more in them.

The two strange features observed in seedlings were:

1. Absence of branching at the base of the radicles of control. This indicates the effect of ultrasonics on the meristematic activity and origin of lateral roots.
2. The coiling of the radicles was visible in 50% cases on 14th day and in 100% cases on 18th day in treated seedlings whereas not even a single case of coiling was observed in control.

There occurred more damage to cells on the side of the roots facing the ultrasound source during exposure than on the back side. This shows that ultrasonic waves don't penetrate deep into the root and other tissues. Thus lowering of the mitotic index on the side of ultrasonic exposure is responsible for curling of roots as also recorded in case of *Vicia faba* Levitt, (1980). The favourable effects of the ultrasound waves on germination and seedling growth of some grasses and crop plants were linked with increase in the activity of alpha-amylase and other enzymes (Yaldagard et al. 2008· Machikowa et al. 2013 and Shekari et al 2015). The high frequency, 2 MHz. ultrasound was operative through its more heating effects on the large- sized cotyledons of the castor that hampered the mobilization of food reserves leading to suppression in growth of plumules and germination of seeds. But at the same time, better growth elongation alongwith coiling in radicles was registered. Presowing irradiation of the yellow mustard (*Brassica campestris* L.) seeds with 2 MHz. ultrasound produced seedlings that gave better growth and seed yield at maturity of plants than the untreated control (Maury et al. 2009).

References

Levitt, J. (1980). Responses of plants to environmental stresses. II. Water relation, salt and other stresses. Acad. Press N.Y. pp 606.

Yaldagard, M., Mortazavi, S.A. and Tabatabaie, F. (2008). Influence of ultrasonic stimulation on the germination of barley seed and its alpha-amylase activity. African Jour. Biotech. 7 (14) : 2465-2471.

Machikowa, T., Kulrattanarak, T. and Wonprasaid, S. (2013). Effects of ultrasonic treatment on germination of synthetic sunflower seeds. International Jour. Biol. Biomole. Agric. Food Biotech. Engg. 7 (1): 1-3.

Shekari, F., Mustafavi, Seyyed –Hamid and Abbasi, A. (2015). Sonication of seeds increase germination performance of sesame under low temperature stress. Asia Agriculture Slovenica. 105(2): 203-212.

Maury, A.N., Singh, H.K., Singh, A.K., Swarup, R. and Singh, Y.P. (2009). Seed sonication; an effective biotechnical device in promoting growth and agronomic yield of yellow mustard (Brassica campestris L.). Modern J. Life Sci. 8(1-2): 25-28.