THE EFFECT OF COLD PLASMA OBTAINED IN VACUUM ON *TRITICUM AESTIVUM* L.

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Abstract

Seeds of *Triticum aestivum* L. were exposed in cold plasma obtained at low pressure (vacuum) for 2, 3, 5, 10, 20 and 40 minutes respectively, resulting six experimental variants which have been compared with the control ones. After that they were putted to germinate in laboratory conditions, using Petri dishes on double filter paper. The dynamic of germination and the growth in length of the roots and the sheets of the plantlets was monitorized during the first phenophase. Ten days after exposure to the cold plasma, the content of photosynthetic pigments has been obtained spectrophotometrically. The germinative response of the wheat seeds showed no differences between treatment variants regarding to control variant. We can specify that the seed used in this study had a maximum native germinative potential because they are produced in the earlier year. Our reslts show that a negative correlation exists between the root length and the exposure time in cold plasma. The same behavior has been registered for the sheet length of the plantlets. Regarding the photosynthetic pigment content surprising is the fact that, after a decrease at two minutes of exposure, a slow increase for 5 and 10 minutes is registered. After that the decrease of photosynthetic pigment content for the last time exposures is emphasized. These results suggest the fact that clod plasma obtained in vacuum affects both the root length and the sheet length, while the photosynthetic pigment content shows an accommodation to the stress produced by the first exposure. Therefore for the higher time of exposure, the content of these pigments follows the behavior of the other studied quantities.

Key words: seeds, plantlets, photosynthetic pigments, cold plasma

Cold plasma effects have been presented for many domains starting with material science. Plasma treatment could increase hydrophobic property of a polymer surface not hydrophilic and a good hydrophobic property could modify polymer surface (Chen K.S. et al., 2008).

Recently, there has been considerable interest in investigating various physical properties of quantum plasmas since the quantum plasmas have been achieved in semiconductor devices and as well as in dense laser produced plasmas. Moreover, the quantum plasmas have been found in various dense astrophysical environments (Jung Y.D, Murakami I., 2005).

Very recently could plasma has been also applied in biology and biomedicine as well. (Selcuk et al., 2008) used plasma for the inactivation and/or elimination of two pathogenic fungi, *Aspergillus* spp. and *Penicillum* spp. artificially contaminated on seed surface. The plasma treatment reduced the fungal attachment to seeds below 1% of initial load depending on the initial contamination level, while preserving germination quality of the seed.

Effects on seeds of agricultural plants and to some non-commercial species have been also described. Cold plasma treatment was applied by Sera and coworkers (Sera B. et al., 2009) for stimulation of germination of seeds of *Chenopodium album*, with different starting germinations and in different stages of dormancy. Germination rate for the untreated seeds was 15% while it increased approximately three times (max 55%) for seeds treated by plasma from 12 minutes to 48 minutes. Plasma treatment changed seed germination in wheat and oat (Sera B. et al., 2010). Wheat and oat corns have been treated by cold plasma, during 0 to 2400s. These results show that the plasma treatment inhibited the germinating acceleration of wheat in first days but enhancement of footstalk was observed on plants grown from seeds treated for medium time. On the other hand, plasma treatment did not affect germination of oat seeds, but accelerated the rootlet generation at plants grown from treated seeds. The different chemical compound contents illustrated changes in metabolism processes in both tested species.

Plasma and radio-wave technologies have been as pre-treatments of seeds to stimulate their

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germination and to sterilize the fungal and bacterial plant pathogens. Filatova and coworkers (Filatova I. et al., 2011) studied the influence of low temperature 5.28 MHz plasma as well as electromagnetic field on seed sowing qualities and yield for some grains and legumes.

The aim of this work is the study of the effects of cold plasma at low pressure in vacuum on wheat growth plantlets.

MATERIAL AND METHOD

The experiments where conducted in Institute of Systems Biology and Ecology, Czech Republic and in University of Agricultural Sciences and Veterinary Medicine from Iasi. Seeds of *Triticum aestivum* from 2010 year were exposed in cold plasma obtained at low pressure (vacuum) for 2, 3, 5, 10, 20 and 40 minutes respectively, in Ceske Budejovice from Czech Republic. A commercial (Sairem) surfatron and microwave generator (Sairem GMP03 KE/D) were used for plasma generation. Four windows facilitates observation of the discharge and served as ports for handling the samples into and out of the chamber. Experimental device contains a stainless steel vacuum vessel and an upper flange made of plastic in order to enable the propagation of the surface wave. Plasma generated in this way was sustained further downstream by a surface wave and exited out of the open tube end.The required gas composition used was prepared by mixing the working gases (technical Ar, N2 and O2) and using MKS mass flow-controllers (Sera B. et al., 2008).

The samples of treated seeds were placed into glass Petri dishes (40 mm in diameter) and the distance between the nozzle outlet and the bottom of Petri dish was 2 cm. The temperature of discharge, measured simply by thermistor, was about 53^0C.

As a result six experimental variants which have been compared with the control ones. After plasma treatment the wheat seeds were putted to germinate in laboratory conditions in Iasi, using Petri dishes on double filter paper. The dynamic of germination and the growth in length of the roots and the sheets of the plantlets was monitorized during the first phenophase. Ten days after exposure to the cold plasma, the content of photosynthetic pigments has been obtained spectrophotometrically (Foca N. et al., 2004) and calculated using Lichtenhaler formula (Lichtenhaler H.K.,1983).

RESULTS AND DISCUSSIONS

The germinative response of the wheat seeds showed no differences between treatment variants regarding to control variant. We can specify that the seed used in this study had a maximum native germinative potential because they are produced in the earlier year.

The root dimensions for the control plant and the different variants are given in figure 1 and the sheet dimension in figure 2.

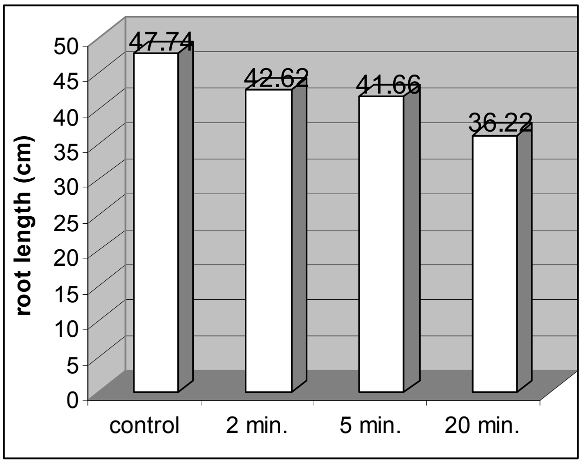

Figure 1 **Total wheat root dimensions (cm) after 10 days**

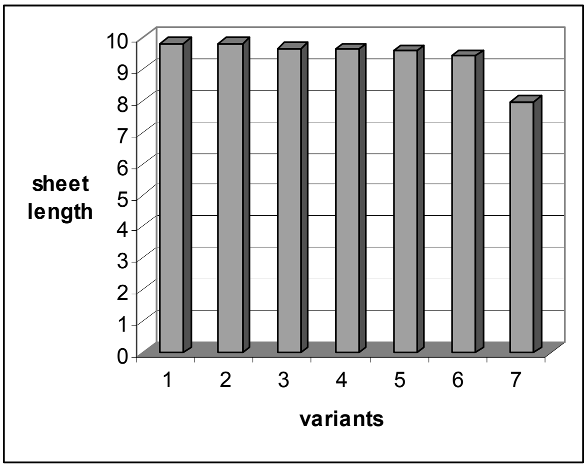

Figure 2 **Wheat sheet dimensions (cm) after 10 days**

From figures 1 and 2 we can see that both the root length and the sheet length of the control plants are higher than the exposed plants to the cold plasma.

Our results for the content of photosynthetic pigments are given in figures 3, 4 and 5.

From figures 3, 4 and 5 we can see that the photosynthetic pigment content shows an accommodation to the stress produced by the first exposure.

For the higher time of exposure, the content of these pigments decreased and finally, for the highest time of exposure this content remains approximative constant.

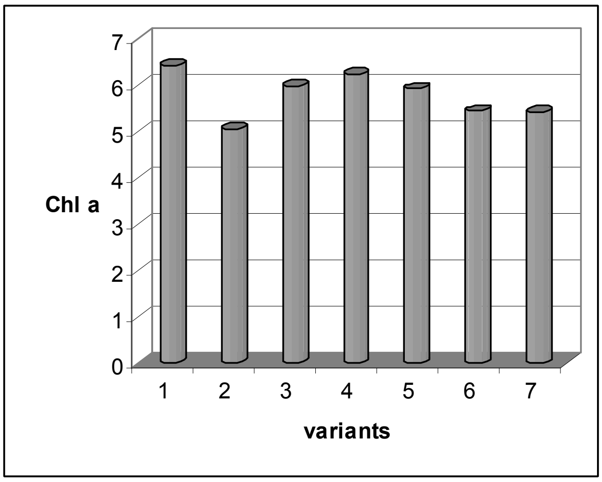

Figure 3 Chlorophyl a content from wheat leaves after 1

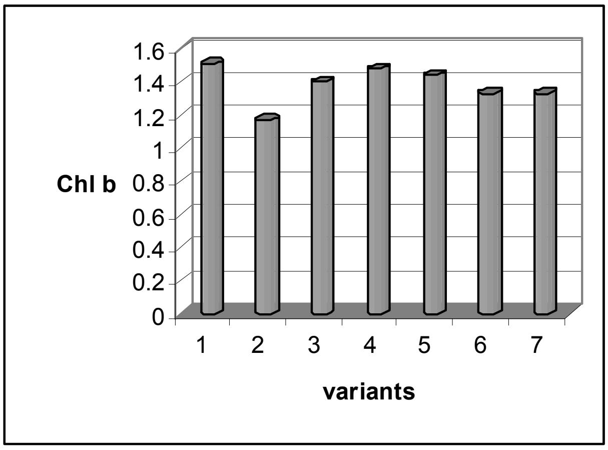

Figure 4 Chlorophyl b content from wheat leaves after 10 days

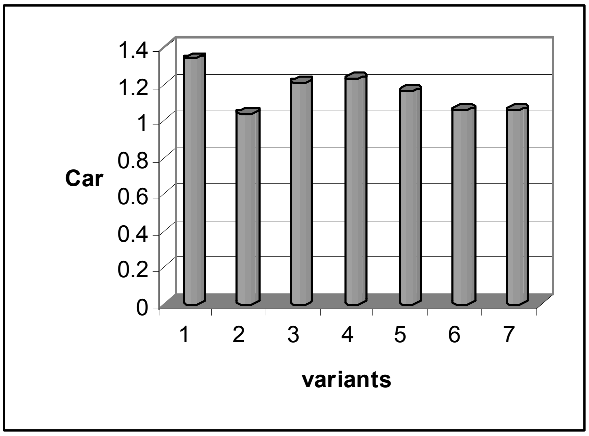

Figure 5 Carotenoid content from wheat leaves after 10 days

CONCLUSIONS

Our reslts show that a negative correlation exists between the root length and the exposure time in cold plasma. The same behavior has been registered for the sheet length of the plantlets. Regarding the photosynthetic pigment content surprising is the fact that, after a decrease at two minutes of exposure, a slow increase for 5 and 10 minutes is registered. After that the decrease of photosynthetic pigment content for the last time exposures is emphasized. These results suggest the fact that clod plasma obtained in vacuum affects both the root length and the sheet length, while the photosynthetic pigment content shows an accommodation to the stress produced by the first exposure. Therefore for the higher time of exposure, the content of these pigments follows the behavior of the other studied quantities.

Up to now, no direct evidence for understanding the influence of plasma treatment on seed germination, and early growth. There are studies which intented to explain the mechanism of modification of structure and function of biopolimers in order to explain these effects on plant growth (Motrescu I. et al., 2009, Motrescu I. et al., 2010). In the future, it is necessary to perform more experiments to obtain more evidence for the determination of mechanism of these effects. The experiments may be based on using various plasma settings and on seeds from various plant species.

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