Effect of non-thermal plasma on the germination and early growth of tomato seeds

M. Magureanu[1], D. Dobrin[1], M. Gidea[2]

[1] *Department of Plasma Physics and Nuclear Fusion, National Institute for Lasers, Plasma and Radiation Physics, Magurele-Bucharest, Romania*
[2] *University of Agronomic Sciences and Veterinary Medicine, Bucharest, Romania*

The influence of non-thermal plasma on tomato seeds has been investigated using a fluidized bed DBD reactor. The discharge was generated in air at atmospheric pressure and room temperature using sinusoidal voltage of 50 Hz frequency and 18 kV amplitude. It was found that plasma slightly enhanced germination rate and significantly influenced growth parameters. The roots and sprouts of plasma treated seeds were longer than those of the untreated samples, for treatment durations of 5-30 min. The effect is more pronounced for the root length. The most substantial increase was obtained for seeds treated in plasma for 5 min: the average root length was 2.88 cm, while for the control samples it was 1.01 cm.

Non-thermal plasma started to be investigated in the field of agricultural science as an alternative to traditional pre-sowing seed treatment. Early work on plasma treatment of seeds was carried out at low pressure, in RF and microwave discharges [1,2]. More recently, atmospheric pressure plasma started to be studied for this purpose [3,4]. Generally, it was found that seed germination was accelerated and plant growth was stimulated as a result of plasma exposure [1-4]. Various mechanisms are proposed to explain this effect, from modification of seed surface, influencing wettability and water uptake [2-5] to deeper changes affecting seed metabolism [3].

In the present experiments, tomato seeds were exposed to plasma generated in a dielectric barrier discharge (DBD) at atmospheric pressure, with high air flow (15 L/min), so that the seeds are held in suspension within the discharge zone. The expected advantage of this fluidized bed reactor is the more uniform treatment of the seeds due to their continuous movement in the plasma region. A coaxial DBD reactor was used, with sinusoidal voltage of 18 kV amplitude and 50 Hz frequency.

The distributions of plants as a function of their root and sprout lengths are shown in Fig. 1. The germination increased slightly as a result of plasma exposure: 68% - control seeds, 77% - seeds treated for 5 min. The roots and sprouts of plasma treated seeds (t=5-30 min) were longer than those of the control ones. The most substantial increase in length was obtained for seeds exposed to plasma for 5 min: the mean root length (MRL) was 2.88 cm as compared to 1.01 cm for untreated seeds and the mean sprout length (MSL) was 3.3 cm as compared to 2 cm for control seeds.

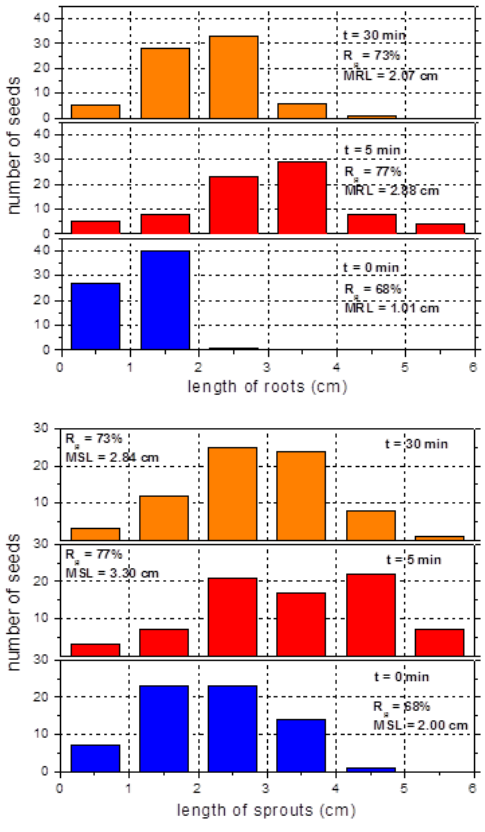

Fig. 1. Distribution of plants as a function of: (a) – root length; (b) – sprout length for control seeds (t = 0 min) and for seeds treated in plasma for 5 and 30 minutes

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