



## Plasma Technologies: A Radical New Approach to Farming

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### INTRODUCTION

In recent times, agriculture is facing several problems due to the continuous world population growth, the environmental pollution, and climate change. In particular, the global population growth leads to an increased food demand and climate change has caused significant reductions in crop yield. The current situation calls for agricultural research to ensure food security while keeping detrimental effects of agriculture on the environment to a minimum. By improving the seed germination and plant growth we could meet the world population food needs. Indeed, the major cause of low germination of seeds of various plants is often connected to the seed surface and soil contamination with microorganisms and fungi. Until now, conventional techniques such as irrigation, fertilization, and crop protection have been implemented in order to increase the production. However, these methods present economic and environmental disadvantages. Increasing agricultural productivity, taking into account protection of the environment, must therefore be addressed with novel approaches. One such approach is use of plasma technology. Plasma technologies have been leveraged for advantaged physical and/or chemical treatment of crops, seeds, and soil. The beneficial effects of plasma arise from the cocktail of reactive neutral species, charged species (electrons, ions), electric fields, and ultraviolet radiation produced in the discharge. The action of plasma species contributes to the seed germination, seed disinfection, plant growth, insect control, retention of quality of agricultural products, and soil remediation, which altogether can contribute toward an increased food production and realization of sustainability.

### **Plasma Treatment on seed**

Seeds are in dormancy state (inactive state) until they get suitable conditions for the germination. Plasma helps to form reactive species like nitrous oxide during Plasma Discharge which breaks the seed dormancy. Thus, Plasma boosts the seedlings' growth. It results in the positive growth and development of the seedlings. Another consequence of the plasma treatment is the modification of surface properties. The change of wetting properties and structure of the coat increases the water uptake and the permeability of nutrients, and it can accelerate the development of the roots.

### **Soil and plant treatment**

A key parameter for productivity in agriculture is the remediation of soil. Plasmas could provide an alternative ecological and low-cost technology for decontamination and modification of soil thanks to its radicals, being very reactive with fewer effects in the long term than conventional chemicals. The challenge in soil remediation is to enable a selective treatment to reduce fungi and detrimental bacteria while preserving or enhancing the activity of nitrogen-fixing bacteria. In fact, plasma can meet these challenges and can as well protect from detrimental outcomes of continuous cropping. The effects of plasmas are moisture and soil material dependent.

Plasma for increasing nutritional content

Using the plasma technology in the growing of food allows the plant to increase their complex amino acid structures and mineral content. This gives you healthier plants with a longer shelf life and stronger flavors. Higher nutritional values mean increased health in the population eating these crops, and in turn, lowering the costs of healthcare for the nation.

### **Plasma treated Water**

The use of plasma-activated water (PAW) rather than direct plasma treatment is, also, a possible approach. PAW could double the nitrogen content in the leaves of plants, increase the leaf area and dry weight, and reduce the bacterial density by five orders of

magnitude in hydroponic water. Indeed, the growth rate of the plants increased with the plasma irradiation time and the nitrate and nitrous nitrogen ions were produced by the application of plasma irradiation to the drainage water improving the plant growth rate. Finally, PAW is an environmentally friendly and cost-effective disinfectant.

### **Plasma technology for extending growing season**

The plasma creates a new environment around the plants. This environment allows the farmer to extend the growing season of the plant, enabling summer crops to grow into winter and winter crops extending into summer. Two crops per growing season have been achieved because of hardier plants and quicker growth. An extended growing season gives farmers more flexibility and tolerance to changing weather patterns and allows farming to become less weather dependent.

### **Increased Yields**

Increases of up to 80% have been achieved in large scale trials. Yields on fruiting vegetables such as tomatoes, peppers, cucumbers and eggplants have show increases from 20% to 100%. Fruit trees have shown significant differences in size and quantity of fruit. Older trees can be brought back to their prime.

### **Benefits of plasma technology in agriculture**

- Boost Germination Speed
- Seed Treatment in Short Time
- Low-temperature Treatment
- Plasma generation in surrounding air
- Low Operating Costs
- Environment Friendly

### **Drawbacks of plasma technology in agriculture**

- Large number of Samples
- Investment Costs
- Adaptation Mechanisms
- Determination of effective dose

## CONCLUSION

Plasma Technology in Agriculture will herald a new age of enhancing the health and well-being of plants and soils, which will in turn create the abundance needed for farmers to be economically stable. It has potential to

completely revolutionize agricultural practices, enhance environmental health and healthy living for both producers and consumers, and virtually eliminate external inputs in agricultural systems across the world.