

# **Humates for Seed Enhancement and Hydroponic Production**

**Vladimir Vasilenko, Ph.D. (Plant Biology)**

## **I. OVERVIEW**

**The author's results showed that derivatives of humate products particularly the fulvic acid fraction increased the percentage of germination of tomato seeds. Stem heights and diameters of the tomato plants also increased as result of humate application in hydroponic harvesting. A positive effect of humic substances upon chlorophyll content in leaves correlates with higher yield of treated plants. The humates substantially increased the average diameter of fruits and number of fruits per a cluster. Total biomass of fruits of treated plants exceeded control up to 38-42%. New technology of humate application can be lucrative for hydroponic and seed enhancement even today.**

## **II. BACKGROUND**

Humates are the salts of humic acids and come from the remains of plant and animals millions of years ago. Humic acids are naturally present in soil organic matter; they are a large family of organic compounds with unique characteristics. Among the various sub-fractions of the humates, the division between humic acid and fulvic acid fractions is of most importance. Fulvic acids are generally more plant active because of their higher oxygen content, and because of the abundance of carboxyl (COOH) groups. Humic acids are generally considered more important for soil remediation. The lay public generally refers to humic acids and fulvic acids as simply humic acids. While both fulvic acids and humic are both complex organic molecules, humic acids are recognized to have greater molecular weight. The molecular structure of these molecules identified by U-Mate International Inc. (Scottsdale, Arizona). To the organic chemists the unique atomic groupings suggest a multiplicity of uses and reactions.

What do humic acids do? First, they physically modify and improve the soil and biologically stimulate the plant. They can increase the rate and percentage of seed germination and stimulate plant growth by accelerating cell division, increasing the rate of development in root systems, and increasing the yield of dry matter. They have no detrimental effects on quality of products. The humates used for these trials were provided by U-Mate International Inc. of New Mexico USA. Importantly their humate products have been certified organic by the Organic Material Review Institute of Eugene, Oregon USA. Humic acids can improve the uptake of phosphates from banded fertilizers. An added benefit of applying humic acids with liquid fertilizers is their ability to buffer the salinity and toxicity of fertilizers. Experiments conducted on wheat (Vaughan and Malcolm, 1985) using distilled water and Hoagland Solution demonstrated that humic acids improved Hoagland's solution and increased root and shoot biomass in distilled water as well. Sladky (Sladky Z., 1959) demonstrated that humic acids improved not only the vegetative growth of tomato plants grown in nutrient solution, but increased the respiration rate and the chlorophyll density of the plants.

## **III. PURPOSE OF RESEARCH**

The purpose of the research was to investigate the possible benefits of supplementing existing plant fertilizers with humic and fulvic acids derived from humates. In addition, the practicality of using humates in commercial and agricultural settings. Moreover, the extent to which positive trial data could be used by today's agronomists, field-men, and growers. Furthermore, trial results could show improved yields and corresponding farm profitability.

## **IV. RESEARCH RESULTS**

Our research on humic substances was conducted in conjunction with company U-Mate International Inc which provided a source of humic and fulvic acids- "Ancient Earth"™ and company-Pioneer Fruits& Vegetables (Leamington-Ruthven, Ontario) where the trials were done on hydroponic tomatoes. A micro-biologically activated working solutions of humates and fulvates (the salts of fulvic acids) was prepared to the experiment with using an original formula (property of U-Mate International Inc., modification of Dr. V.Vasilenko). The germination trials with three different varieties of tomato seeds have been done first. Seeds were soaked in water solutions of the "fermented" humates and fulvates.

The seeds, which were soaked in solution of fulvates, had the highest percent germination (**Fig.1**). The germination in control was 77 percent only whereas for the seeds, which were soaked in the solution of fulvates, the germination was 88% on day 16 from sowing. The “treated” plants looked more healthy and greener (apparently had more chlorophyll) as well.

The next trials were done at real conditions of growing of hydroponic tomatoes (cv. *Rhapsody*). The three weeks old tomato plants have been transplanted to the company greenhouse few days before the trial. The solutions of humates and fulvates were added in rockwool blocks one time at two stages of growing- a young tomato (of one month old) and at a fruit-bearing stage (seven months old approx.) Four different concentrations of solutions were tested (10, 15, 30, 50 and 100 ml. per a plant). The data were collected from approximately two hundred of independent measurements on day 10th- 14th after the application of humic substances.

Humic substances changed a growth pattern of treated tomatoes. As a result of such application the stem's height and stem's diameter as well as amount of chlorophyll in leaves increased substantially but effects vary depends on what kind of substance was applied and its concentration. In general, fulvates were more effective in the stimulation of plant's height (87.6 cm for Control vs. 93.8 cm for Fulvate-100ml/plant) and chlorophyll accumulation (10% more for Fulvate- 10 and 50 ml.) but humates showed better effect on stem diameter: 12.76 mm for Control vs 14.11 mm (11% more) for Humate-50 ml/plant. The results showed that there is a correlation between applied amount of the substances and their physiological effects on the plants. For example, a doze of 10-15 ml. was often not sufficient for producing a significant effect but application of 100 ml/plant resulted in some cases to growth suppression.

The following parameters of the yield were assessed at the late stage of growth- average number of fruit clusters per a plant; number of fruits per a cluster and diameter of the fruits (**Fig.2**). The humates substantially increased the average diameter of fruits. It was  $5.60 \pm 0.22$  cm (100%) for Control and  $6.52 \pm 0.19$  cm (116.4%) for the treatment. Number of fruits per a cluster significantly increased as well ( $4.02 \pm 0.17$  for Control and  $4.50 \pm 0.18$  (112%) for the treatment). Number of fruit clusters per a plant was slightly greater (105.5% to control at  $P=0.05$ ), probably, due to acceleration effect of humates on speed of growth and development of the plants. An average biomass of fruits of control and treated plants was accounted as the result of such assessment (see the graph: last two columns on right). The total biomass of fruits of treated plants exceeded those in control by 38-42%.

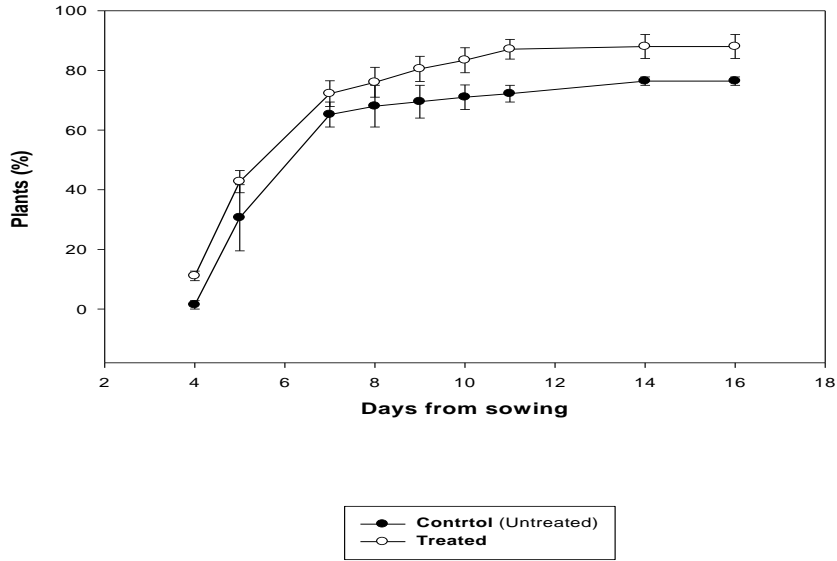
## **V. CONCLUSION**

The data obtained in the trials allowed us to make a conclusion about effects of the humic substances on tomato plants:

- 1.) The results showed that derivatives of fulvic acids increased the percent germination and therefore could be used in seed enhancement technologies;
- 2.) The results demonstrated a certain difference between humates and fulvates related to the parameters of growth and development;
- 3.) The stem growth (height and diameter) of tomato increased as result of humate application
- 4.) The data showed the positive effect of fulvates upon chlorophyll content in leaves that can correlate with high rate of photosynthesis and yield of treated plants.
- 5.) The total biomass of fruits of the plants treated with humates and fulvates significantly exceeded those in control.

The results can be used in further development of technology of humate application for hydroponic. The author possesses original formulas of compositions of humic and fulvic acids with micro nutrient elements and vitamins. New technologies of seed enhancement with humates and hydroponic technologies can be lucrative for growers even today. For example, the growers can reduce a growing area up to 25-30% and save a substantial number of resources as result of humates application without any losses of production and to get even a better-quality yield.

**Fig. 1. Effect of Fulvates on Percent Germination of Tomato Hybrid H1.**



**Fig 2. Effect of Humates on Yield of Tomato "Rhapsody"**

