Gelatin based gels used as biostimulators for tomato crop

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Abstract The aim of this paper is to obtain gels with biostimulatory effect for tomato crops from leather industry by-products. Two gels based on bovine gelatin were formulated. First gel was obtained from bovine gelatin and microelements, the second gel was obtained from bovine gelatin, keratin hyrolysate and microelements. The obtained gels were characterized according to the standards in force or literature methods for: dry substance, ash, total nitrogen and protein content, aminic nitrogen, pH, content in aminoacids, bloom test and viscosity.

The gels were used for tomato plants in two different stages of vegetation: seedling stage and prick-out stage as root biostimulant. Plant growth is stimulated when gelatine is used as root biostimulant due to better transport of amino acids in plants. The antimicrobial activity of gels was tested for *Fusarium oxisporum* and *Botrytis cinerea*. Tests have shown that the gels have very good antimicrobial activity. Treated plants and control plants were monitored throughout the vegetation period. Measurements were made for the length, diameter and number of leaves during the seedling period. Also in this stage of vegetation, the content of total chlorophyll and soluble carbohydrates was measured. After ripening the fruits, the content of vitamin C, lycopene, carotene, total polyphenols, total soluble carbohydrates and total acidity were measured.

The measurements made on tomato plants in different stages of vegetation showed that plants treated with gels had a better development compared to control plants treated with water.

Keywords: protein gels, biostimulatory effect, tomato crops, chlorophyll content, antioxidant activity

Introduction

High productivity and maintaining soil fertility are of particular importance for agriculture in the context of global population growth and increasing food requirements. The excessive use of chemical fertilizers to compensate for nitrogen deficiency in the soil has created numerous environmental problems in various ecosystems [1]. An alternative to chemical fertilizers is represented by biostimulators obtained from protein hydrolysates extracted from by-products of animal or plant origin. Biostimulators are products capable of acting on the metabolic and enzymatic processes of plants, increasing the production yield and the quality of crops. It also helps plants to deal with abiotic stress, especially in the early stage of plant development [2]. The European Biostimulants Industry Council (EBIC) defines biostimulants as "substance(s) and/or microorganisms whose function, when applied to plants or the rhizosphere, is to stimulate natural processes to improve/help nutrient absorption, potentiate nutrient efficiency, increasing tolerance to abiotic stress and crop quality.

In this paper two gels based on bovine gelatin with addition of microelements and keratin hydrolysate were tested on tomato crops and the effects on seedling, and fruits were measured. The gels determined differences between treated and untreated plants regarding biometric parameters and content in vitamin C, lycopene, carotene, total polyphenols, total soluble carbohydrates and total acidity.

Materials and methods

Wool and bovine hide were purchased from a local slaughterhouse and a sheep farmer from Constanta County, Romania. Ammonia (25%), sodium carbonate, formic acid and sulphuric acid were purchased from Chimopar SA (Bucharest, Romania). Acetic acid and sodium hydroxide were bought from Redox SA (Ilfov, Otopeni, Romania). SC Triderma SRL (Bucharest, Romania) supplied Borron SE (ethoxylated alkyl deriva-tives with 65% concentration). All reagents were of analytical grade and were used as such.

The gelatin was obtained by acid hydrolysis from bovine delimed hide at high temperature. The keratine hydrolysate was obtained from sheep wool by alkaline hydrolysis. Gels were analyzed according to the standards in force or in house methods regarding the content in dry substance, total ash, total nitrogen and protein content, pH, bloom test and viscosity. The gel containing bovine gelatin and microelements was labeled GB3M, the gel containing bovine gelatin, keratin and microelements was labeled GB3MK.The seedlings were measured regarding biometric parameters (plant length, diameter, number of leaves, root development) and content in total chlorophyll and soluble carbohydrates. Tomato fruits were analyzed regarding the content of vitamin C, lycopene, carotene, total polyphenols, total soluble carbohydrates and total acidity. Methods used for the measurement of these parameters were according to the standards in force or in house methods.

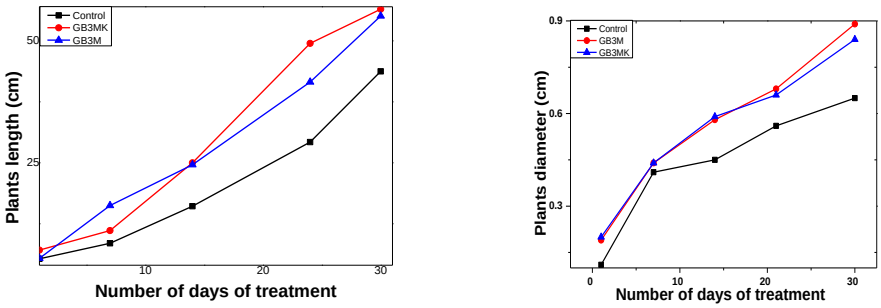
Results and discussions

Gels obtained from bovine gelatin, keratin and a solution of microelements are presented in Figure 1. GB3MK gel has a darker color due to keratin content. The green color is due to microelements solution.

Figure 1. Gels obtained from leather industry by-products

The physical –chemical analyses performed on the two gels showed that the concentration of two gels are similar as well as the ash content. The bloom test and the viscosity are lower for GB3MK due to its content in keratin.

The biometric measurements made on tomato seedlings have shown that treated plants had a better development as can be observed in figure 2. The treated plant also dad a higher content in total chlorophyll and soluble carbohydrates.



a) b)

Figure 2. The evolution of growth in length a) and diameter b) of plants treated with gelatin based gels

After fruit ripening, it was determined that the yield of plants treated with GB3MK product was higher than that of the other two variants (plants treated with GB3M and control). In addition, the fruits of plants treated with GB3MK product had the higher content in vitamin C, lycopene, carotene, total polyphenols and total soluble carbohydrates.

Conclusions

Two gels based on bovine gelatin, microelements and keratin were obtained and tested on tomato seedlings. The gels were characterized physical-chemical. The measurements made on tomato plants in different stages of vegetation showed that plants treated with gels had a better development compared to control plants treated with water.

References

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