

Bioassimilable sulfur (NATURDAI S-SYSTEM) provides effective control of Powdery mildew in tomato enhancing plant immune system

A.I. González-Hernández¹, C. Agustí-Brisach², E. Llorens¹, P. Troncho¹, B. Vicedo¹, M. Mateu¹, T. Yuste², M. Orero², C. Ledó², P. García-Agustín¹ and L. Lapeña¹

Abstract

Development of alternatives to the use of chemical pesticides to control pests are focused in the induction of natural plant defenses. The study of new compounds based on liquid bioassimilable sulfur and its effect as inductor of the immune system of plants would provide an alternative option to farmers to enhance the plant resistance against pathogen attack such as powdery mildew. In order to elucidate the efficacy of this compound in tomato against powdery mildew, we tested several treatments curative foliar, preventive foliar, preventive in soil drench and combining preventive in soil drench and curative foliar. In all cases, we analyzed the infection development, physiological parameters and high level of chlorophyll. We also monitored parameters involved in plant resistance through evaluation of ROS response, callose deposition and hormones levels. The results indicate that preventive and curative treatments can be highly effective for the prevention and control of powdery mildew in tomato plants and foliar treatments are able to stop pathogen development when applied as curative. Soil drench treatments induce immune response mechanisms of plants, increasing significantly callose deposition and promoting plant development.

Keywords: Bioassimilable sulfur, powdery mildew, tomato, induced resistance

Introduction

Development of alternatives to the use of chemical pesticides to control pests are focused in the induction of natural plant defenses (Kravchuk *et al.*, 2011; Llorens *et al.*, 2013; Arenaga *et al.*, 2014). The study of new compounds based on liquid bioassimilable sulfur (NATURDAI S-SYSTEM) and its effect as inductor of the immune system of plants would provide an alternative option to farmers to enhance the plant resistance against pathogen attack such as powdery mildew. The main goal of this study was to elucidate the efficacy of NATURDAI S-SYSTEM in tomato against powdery mildew.

Material and Methods

Several treatments with NATURDAI S-SYSTEM were tested. Following treatments combinations were performed: curative foliar, preventive foliar, preventive in soil drench and combining preventive in soil drench and curative foliar. In all cases, we analyzed the infection development, physiological parameters and the level of chlorophyll. We also monitored parameters involved in plant resistance through evaluation of peroxide accumulation (DAB method), callose deposition (aniline blue staining) and hormones levels (mass spectrometry). All methods described in Llorens *et al.*, 2013.

¹ Group of Biochemistry and Biotechnology, Department of Agricultural Sciences, Universitat Jaume I (UJI) of Castellon, c/Vicent Sos Baynat, s/n, 12071 Castellon de la Plana, Spain, leonor.lapena@uji.es

² Research and development department, IDAI Nature SL, c/Moscú, 10 Polígono Industrial Mas de Tous, 46185 La Pobla de Vallbona, Valencia, Spain, laboratorio@idainature.com

Results and Conclusions

The product reduces the incidence of Powdery mildew infection in all treatments tested. Naturdai Bio-S has an enhancing effect of plant growth and chlorophyll levels in soil treatment or combined with foliar curative treatment (Table 1). The tested product reduces peroxide accumulation up to 90 % and increase callose deposition. SA and JA pathways, related with induced resistance, increase their activity with the treatment (Table 2).

Table 1: Effect of treatment with S-SYSTEM NATURDAI on the infection rate and physiological parameters. The data show the average of three independent experiments. Different letters represent statistically significant differences ($p < 0.05$ least-significant difference test).

	Ratio of infection	Height (cm)	Chlorophylles (SPDA)
Control	0	26.8±0.9 b	31.4±1.1 bc
Control infected	2.4±0.3 a	23.2±0.9 c	28.5±3.4 c
Foliar	1.0±0.1 c	27.0±0.6 b	28.7±3.4 c
Foliar preventive	0.2±0.1 d	26.5±1.1 b	29.7±1.1 c
Soil	0.9±0.2 c	36.8±2.1 a	35.4±0.8 a
Soil + Foliar curative	1.2±0.2 b	36.4±0.7 a	33.2±0.7 b

Table 2: Effect of treatment with S-SYSTEM NATURDAI on parameters involved in plant resistance. The data show the average of three independent experiments. Different letters represent statistically significant differences ($p < 0.05$ least-significant difference test).

	Peroxido (pixels per image)	Callosa (pixels per image)	JA (ng/g)	SA (ng/g)
Control	1604±659 d	0±0	4.3±1.1 c	10.9±0.5 e
Control infected	39272±3108 a	3375±1758 d	4.9±0.2 c	260.2±58.6 b
Foliar	8937±2905 b	18170±2749 c	8.6±1.3 a	367.1±41.6 a
Foliar preventive	9357±2716 b	21401±8090 bc	6.2±1.9 b	256.9±6.8 b
Soil	4827±1336 c	54193±14585 a	9.9±0.2 a	64.2±37.3 d
Soil + Foliar curative	7032±950 bc	30212±5391 b	4.9±2.5 c	148.4±0.2 a

Our results demonstrated that liquid bioassimilable sulfur (NATURDAI S-SYSTEM) could be a potential organic tool in crop protection for the control of Powdery mildew.

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References

- Aranega Bou, P., Leyva, M.d.I.O., Finiti, I., García-Agustín, P. & González-Bosch, C. (2014). Priming of plant resistance by natural compounds. Hexanoic acid as a model. *Front. Plant Sci.* **5**. doi: 10.3389/fpls.2014.00488.
- Kravchuk, Z., Vicedo, B., Flors, V., Camañes, G., González-Bosch, C & García-Agustín, P (2011). Priming for JA-dependent defenses using hexanoic acid is an effective mechanism to protect *Arabidopsis* against *B. cinerea*. *J. Plant Physiol.* **168**: 359-366.
- Llorens, E., Fernández-Crespo, E., Vicedo, B., Lapeña, L. & García-Agustín, P (2013). Enhancement of the citrus immune system provides effective resistance against *Alternaria* brown spot disease. *J. Plant Physiol.* **170**: 146-154.

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