

Comparison of field efficacy of four natural fungicides and metiram against late blight (*Phytophthora infestans* [Mont.] de Bary) on tomato – Short Communication

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Abstract

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Fungicidal activity of asaronaldehyde, soybean lecithin, garlic extract, salicylic acid, and metiram against late blight on tomato was investigated in a field block experiment. Significantly the lowest severity index was detected on plants treated with metiram, while there were no significant differences among plants treated with different natural substances. Mean mass of healthy tomatoes was the highest on plants treated with metiram. It was assumed that severity index was mainly influenced by abiotic factors, especially rain. None of the natural fungicides tested showed satisfactory efficacy against the late blight, therefore new environmentally friendly substances should be studied with the aim of their implementation into sustainable field-grown tomato production.

Keywords: abiotic factors; biotic factors; *Lycopersicum esculentum*; *Phytophthora infestans*, natural substances; yield

Late blight, caused by oomycete *Phytophthora infestans* (Mont.) de Bary, is described as a destructive disease on tomato grown in greenhouses and in the field (JÚNIOR et al. 2006). Especially in the field the infection and spreading of the oomycete are strongly dependent on weather conditions (BENDER et al. 2005). *P. infestans* can infect foliage, stems, potato tubers and tomato fruits at all stages of plant development (MIZUBUTI et al. 2007).

Until now only few natural substances have shown potential for controlling late blight (YANAR et al. 2011). Among several natural substances against phytopathogenic fungi previously tested, asaronaldehyde showed fungicidal properties, also against late blight (Kos et al. 2009). Salicylic acid,

the most important component of field horsetail (*Equisetum arvense* L.), claimed to have also impact on disease resistance of plants (TRDAN et al. 2008), while soybean lecithin was previously described as effective natural fungicide against *Alternaria cichorii* Nattrass (TRDAN et al. 2008). One of the alternatives to synthetic fungicides can be also garlic extract (PORTZ et al. 2008).

The aim of our investigation was to find out whether four natural substances, i.e. asaronaldehyde, soybean lecithin, garlic extract and salicylic acid, are effective for suppressing late blight infection on tomato under field conditions. With determination of the most efficient natural fungicide it would be a basis for its implementation into the field-grown tomato production systems.

MATERIAL AND METHODS

Plant material. In 2010, the trial was carried out on a heavy clay loam soil at the experimental field of the Biotechnical Faculty in Ljubljana (latitude 46°04'N, longitude 14°31'E, 300 m a.s.l.), Slovenia. Tomato (*Lycopersicum esculentum* Mill.) cv. Novosadski jabučar, was used in the research.

Seeds were sown in styrofoam trays filled with a commercial Klasmann Tray® potting media (Klasmann-Deilmann GmbH, Geeste, Germany). The trays placed in the greenhouse were irrigated as required with an automatic, overhead, travelling boom sprinkler system. Six weeks old plants were hand-transplanted into an open field on May 21, 2010.

Treatments. Four environmentally friendly fungicidal substances were used: soybean lecithin (formulation Super F; 0.5%), salicylic acid (formulation Natur F; 0.5 %), asaronaldehyde (0.1%), and garlic extract (10%). Garlic extract was prepared one day before spraying. 400 g of peeled, smashed garlic was put into a glass vial, diluted with 4 l of tap water and stored at 4°C. After 24 h the content of the vial was filtered through gauze. Other two treatments were represented by metiram and the water control. Treatments were repeated every 7–14 days, always early in the morning, and they began 6 weeks before the onset of the first symptoms of late blight.

Field observations and yield evaluation. Slightly modified EPPO numerical scale for assessing the symptoms of *P. infestans* on leafy vegetables (OEPP/EPPO 1997) was used. An evaluation of infected leaf area was made on July 25, August 2, 11 and 25 and September 3. Also the mass of healthy/infected fruits per plant was evaluated. Fruits were collected on July 22 and 27 (II July), August 2, 5, 9 and 12 (I August); August 16, 19, 23, 26 and 30 (II August) and on September 2, 6, 10 and 13 (I September).

Weather conditions. Climate data that were taken into consideration were obtained from the National Meteorological Service of Slovenia (Official Weather Forecast for Slovenia 2015).

Data analysis. ANOVA was conducted in order to establish the differences in mean disease severity index among treatments and evaluation dates. Statistical analyses were performed according to TRDAN et al. (2008). All statistical analyses were performed with Statgraphics XVI program (Statgraphics Centurion 2009). The data are presented as untransformed means \pm SE.

RESULTS AND DISCUSSION

General assessment of *Phytophthora infestans* severity index damage

Based on the statistical analysis of pooled results it can be established that the late blight severity index was influenced by the date of assessment ($F = 2068.77$, $df = 5$, $P < 0.0001$), treatment ($F = 246.27$, $df = 5$, $P < 0.0001$), and interaction between date of application and treatment ($F = 37.59$, $df = 25$, $P < 0.0001$). Plants treated with metiram were significantly the least infected (1.69 ± 0.77) with late blight. There were no significant differences between the level of severity index on plants treated with asaronaldehyde (3.32 ± 0.23), salicylic acid (3.47 ± 0.23), garlic extract (3.47 ± 0.23), soybean lecithin (3.37 ± 0.23), and control treatment (3.61 ± 0.22).

Assessment of yield parameters

Analysis of the pooled results demonstrated that mass of healthy tomatoes was influenced by date of evaluation ($F = 94.27$, $df = 3$, $P < 0.0001$) and treatment ($F = 18.75$, $df = 5$, $P = 0.0075$) (Fig. 1). In our case, late blight severity was affected by different abiotic factors, mostly to weather conditions during the growing season (BECKTELL, DAUGHTREY 2005). Since inoculum commonly occurs, when average temperatures range between 20 and 22°C (JÚNIOR et al. 2006) and with rainy weather (JÚNIOR et al. 2006), it was believed that the massive presence of late blight symptoms was connected to the high rainfall that occurred in the second half of July and in the first half of August. Field in the near vicinity of the parcel, was used for potato and tomato production in the period 2006–2009, therefore infected tomato stems and fruits or potato tubers left near or on the soil surface might have been the main source of primary inoculum (HUSSAIN et al. 2005). The results of our research do not support the use of any natural fungicides tested, but this fact did not discourage the authors from searching for new environmentally-friendly solutions against late blight on field-grown tomato. Already STEPHAN et al. (2005) proved that it is hard to find efficient natural product against late blight. It will be hard to eliminate the need to use copper fungi-

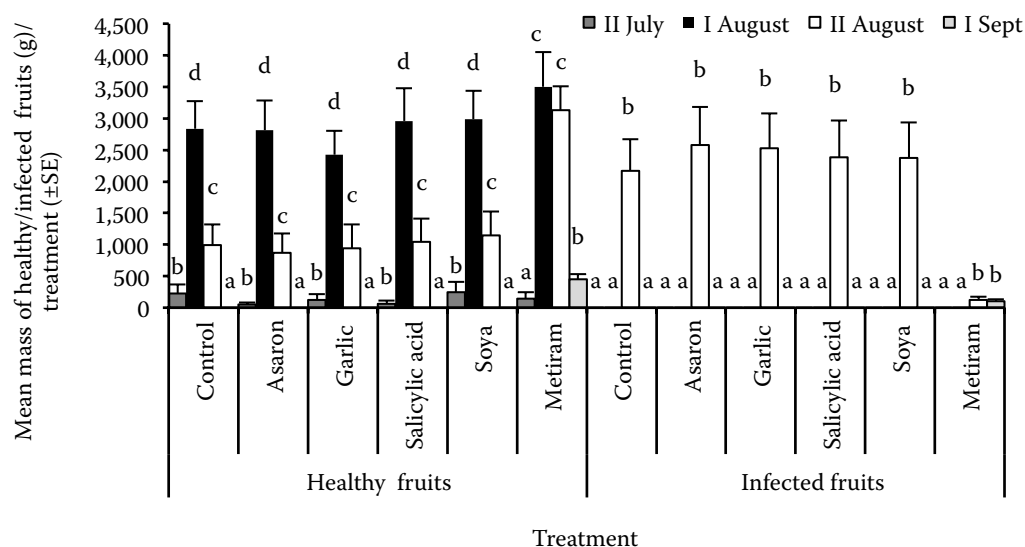


Fig. 1. Mean mass of healthy/infected tomato fruits per treatment (\pm SE)

average values belonging to a specific treatment, followed by the same lowercase letter are not significantly different according to the Student-Newman-Keuls multiple range test ($P < 0.05$); bars represent the SE of the mean; Asaron – asaronaldehyde; Soya – soybean lecithin; Garlic – garlic extract

cides (SPEISERT et al. 2006). It is believed that our future studies will result in finding the effective natural substances for their single use or for the simultaneous use with other ecologically acceptable plant protection methods.

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