Determination of the optimum treatment strategy against the early blight of potato under epiphytotic conditions

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INTRODUCTION

Early blight (EB) caused by Alternaria solani and A. alternata becomes a growing problem for potato production sometimes causing yield losses up to 50%. Due to the lack of EB-resistant cultivars, the early blight control is currently based on cultural practices and use of fungicides. Use of well-timed fungicide programs including a rotation of fungicides with different modes of action is critical for the proper crop protection, as well as for resistance management. The EB control on potato crops drastically depends on the right choice of fungicides and the terms of its application. Thus, potato growers are interested to utilize the most optimum application schedules and combinations of fungicides. However, there are no publications comparing different EB-specific fungicides and protection schemes under conditions of Russian temperate zone, which could be useful for farmers in relation to the choice of the best EB control practice. Thus, the purpose of this study was the evaluation of a biological efficiency of some EB-specific fungicides differing in their functional properties, as well as in the number and time of their recommended applications to determine the optimum EB control strategy under epiphytotic conditions.

MATERIALS AND METHODS

The experiments were arranged on small randomly distributed 42-m^2 plots at the experimental field of the All-Russian Research Institute of Phytopathology (Moscow region) using the EB-susceptible cv. Udacha. Background late blight-specific sprayings of plants with the Revus (0.6 L/ha), Infinito (1.6 L/ha), and Shirlan (0.4 L/ha) fungicides were carried out to exclude a possible influence of the late blight. An artificial infection background was used in accordance with the Euroblight recommendations [1] with some modifications of the inoculum obtaining procedure. Barley grain inoculated with *A. solani* spores was evenly spread across the plots (10-15 g/m^2). In total, 9 experimental variants were studied, each in four replications (Table 1). The evaluated preparations included Revus Top (0.6 L/ha, a.i. mandipropamide + difenoconazole), Signum (0.3 kg/ha, a.i. boscalid + pyraclostrobin), and Penncozeb (1.6 kg/ha, a.i. mancozeb). The first treatment was applied after the plant height exceeded 20 cm; the further treatments were applied every 9–10 days. For each variant, the level of plant affection was determined according to the British Mycological Society scale; the corresponding AUDPC values were calculated according to [2]. The yield was determined after a manual harvesting. The tuber quality was assessed after a one-month storage of harvested potatoes according to [3]. Statistical treatment of the obtained data was carried out by ANOVA at the 95% confidence level.

REFERENCES

1. http://euroblight.net/fileadmin/euroblight/Alternaria/Protocols/Alternaria_solani_field_inoculation_kernels_2015.pdf
2. Shaner G., Finney R.E. Phytopathology 67, 1051–1056 (1977).
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TABLE 1. Fungicide application schemes tested in the study*

Variant	1st treatment (Jun 24, 2019)	2nd treatment (Jul 3, 2019)	3rd treatment (Jul 12, 2019)	4th treatment (Jul 22, 2019)	5th treatment (Aug 01, 2019)	6th treatment (Aug 09, 2019)
1 (Control)	Revus	Infinito	Infinito	Revus	Revus	Shirlan
2	Revus	Infinito	Infinito	**Revus Top**	**Revus Top**	Shirlan
3	Revus	Infinito	Infinito	Revus + **Signum**	Revus + **Signum**	Shirlan
4	Revus	Infinito	Infinito	**Penncozeb**	**Penncozeb**	Shirlan
5	Revus	Infinito	**Revus Top**	Infinito	**Revus Top**	Shirlan
6	Revus	Infinito	Revus + **Signum**	Infinito	Revus + **Signum**	Shirlan
7	Revus	Infinito	Revus + **Penncozeb**	Infinito	Revus + **Penncozeb**	Shirlan
8	Revus	Infinito	**Revus Top**	Infinito + **Penncozeb**	Revus + **Signum**	Shirlan
9	Revus	Infinito + **Signum**	**Revus Top**	Infinito + **Penncozeb**	Revus + **Signum**	Shirlan

* Treatments applied to control early blight of potato are indicated in green; the corresponding EB-specific fungicides are indicated in bold, while late blight-specific fungicides are indicated with regular font.

RESULTS

Weather conditions in the whole vegetation season of 2019 were favorable for the EB development.
In the variant 1 (treated control), a rapid EB development was observed, while variants 2–9, which included protective treatments against EB, showed a significant delay in the disease development. The AUDPC value in the variant 1 was 1670, while in the variants 2–9 it varied from 50 to 980 (Fig. 1). For untreated plants, it reached 2100. The biological efficiency (%) of the tested protection schemes was 63 (var. 2), 68 (var. 3), 52 (var. 4), 73 (var. 5), 79 (var. 6), 41 (var. 7), 96 (var. 8), and 97 (var. 9).
The crop capacity and tuber quality in the variant 1 were significantly lower than those determined for the variants 2–9 (Fig. 2). Among them, the lowest biological efficiency was shown in variants including different schemes of protective treatments with Penncozeb (var. 4 and 7, 52 and 41%, respectively) that may be explained by its lower rain resistance comparing to other preparations tested under conditions of abundant rainfalls in the season of 2019 and insufficient efficiency of the recommended dosage under epiphytotic conditions.
The best protection level was observed in the var. 8 and 9 (biological efficiency 96 and 97%, respectively). The increases in the yield and marketable tuber fraction in the var. 9 (15.2 t/ha and 17%) were almost similar to those in the variant 8.

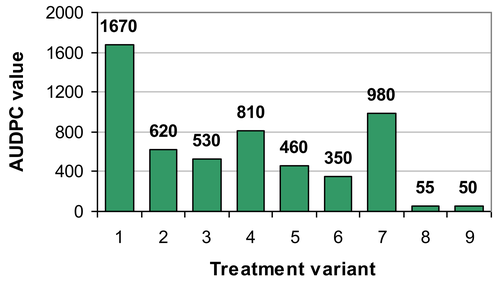

FIGURE 1. AUDPC values ($LSD_{0.95}$ = 65) describing the early blight development in the experimental variants of treatments.

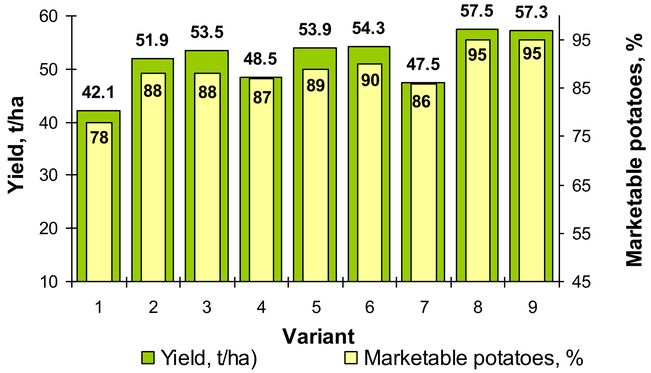

FIGURE 2. The total yield ($LSD_{0.95}$ = 4.5) and marketable fraction of potatoes ($LSD_{0.95}$ = 2.3) in the compared variants of potato protection against early blight.

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CONCLUSIONS

1. A very early (active plant growth stage) treatment against EB is rather inexpedient.
2. Under epiphytotic conditions, the maximum efficiency is provided by the protection scheme, which included a triple consecutive treatment with different fungicides (Revus Top, Penncozeb, and Signum) applied starting from the flowering phase and up to 25 days prior harvesting (biological efficiency 96%, yield increase 15.4 t/ha, 95% of marketable potatoes.