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EVALUATION OF CYTROL AND REVUS FUNGICIDES AGAINST LATE BLIGHT OF POTATO

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ABSTRACT

A field experiment was carried out in 2019 to assess the efficacy of two fungicides namely cytrol 75% WP (thiophanate methyl 35% + chlorothalonil 40%) and revus 240 SC (mandipropamid) to control late blight of potato caused by *Phytophthora infestans*, under field conditions. The experiment was carried out in a randomized complete block design. There were four treatments viz. control, cytrol @ 500 g acre⁻¹, cytrol @ 600 g acre⁻¹ and revus 240 mL acre⁻¹. Data regarding disease incidence and disease control were recorded on 3rd, 5th and 7th days after spray. On day 7th, the highest disease incidence (74%) was recorded in control. All three fungicide treatments significantly reduced disease incidence. Cytrol @ 500 and 600 g acre⁻¹ treatments reduced the disease incidence to 28% and 25%, showing 62% and 66% disease control potential, respectively. Likewise, application of revus 240 mL acre⁻¹ reduced disease incidence to 28% exhibiting 62% disease control potential over control. This study concludes that cytrol @ 500 g acre⁻¹ and revus 240 mL acre⁻¹ can effectively control late blight of potato under field conditions.

Keywords: Cytrol, Disease management, Late blight of potato, Revus.

INTRODUCTION

Late blight of potato continues to be the main biotic constraint all the time. It is caused by *Phytophthora infestans*, a fungus like microorganism that belongs to the oomycetes (Ah-Fong *et al.*, 2017). It is considered a nearly obligate parasite with a narrow host range (Leesutthiphonchai and Judelson, 2018). This pathogenic fungus generally produces oospores, the reproductive structures that are endogenously dormant, can tolerate extremely adverse conditions and remain viable in the soil for at least 3 years (Kiiker *et al.*, 2018). In the mid-nineteenth century, it was best known for its role in precipitating the Irish potato famine that had tremendous effects on human history resulting in population displacement and famine (Pais *et al.*, 2018). It is

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still remaining a major constraint to potato production, the fourth largest food crop and a critical alternate to the major cereal crops for feeding the world's population (Chung *et al.*, 2019). The pathogen can induce 100% yield losses under favorable epidemic conditions in Pakistan (Raza *et al.*, 2020). It is not only causing economic losses but also damages the quantity and quality of the crop. Symptoms of the disease can be seen on tubers, stems and leaves in the form of water-soaked light to dark brown spots with slightly depressed areas (Gold *et al.*, 2020a). Mild temperature and high humidity are the key factors for disease development and under optimal conditions, it can destroy a field in a few days (Gold *et al.*, 2020b).

Management of this devastating pathogen is challenged by its behavior and remarkable speed of adaption to control strategies (Ortiz *et al.*, 2019). Therefore, the development of reliable management tactics is the immediate objective of many researchers. Presently, the most authentic approach is the use of chemical fungicides that has enabled the potato cultivars to grow

prudently in those environments in which late blight is problematic (Khadka *et al.*, 2020). Fungicides namely metalaxyl, cymoxanil, ridomil gold, difenoconazole, fenamidone and mancozeb are used commonly and found to be very effective to overcome the pathogen stress (Mulugeta *et al.*, 2019; Peerzada *et al.*, 2020). The present study was undertaken to check the efficacy of cytol 75% WP (thiophanate methyl 35% + chlorothalonil 40%) and revus 240 SC (mandipropamid) against the late blight disease of potato.

MATERIALS AND METHODS

Field trial: A field experiment was conducted in January 2019 at the village Atari Ajeet Singh, Kot Radha Kishan, Kasur, Pakistan. A potato field infected with late blight disease was selected for chemical control of the disease using fungicides cytol 75% WP and revus 240 SC. The experiment was carried out using a randomized complete block design with four treatments and three replications. Each experimental plot was measured 7 × 10 m². Treatments included a control, cytol @ 500 g acre⁻¹, cytol @ 600 g acre⁻¹ and revus 240 mL acre⁻¹.

A simple manual spray machine of twenty liters was selected for the spray of fungicide. The machine was

filled with five liters of water and sprayed in the control plot for calibration of machine. After sprayed in the control plot, the remaining water was measured with a measuring cylinder and the quantity of water used for one plot was measured. After calculation of doses, the measured dose was put in a spray machine along with three liters of water, thoroughly mixed and then applied in each plot. After application of each treatment, the machine was washed thoroughly and used for next treatment. In control plots, no fungicide was applied. The data regarding disease incidence were recorded randomly from three places from each plot with the help of 1 × 2 m² quadrat. The data were recorded before application of fungicides as well as on 3rd, 5th and 7th day after application of fungicides. The quadrat was thrown randomly and the total number of plants as well as infected plants was counted. The average of three readings was taken, then grand average of both replications was calculated. Disease incidence (DI) was calculated by dividing the number of infected plants by the total number of plants and multiply by a hundred according to the given formula:

$$\text{Disease incidence (\%)} = \frac{\text{No. of infected plants}}{\text{Total no. of plants}} \times 100$$

Percentage control was calculated by using the following formula:

$$\text{Disease control (\%)} = \frac{\text{DI in control} - \text{DI in treatment}}{\text{DI in control}} \times 100$$

STATISTICAL ANALYSIS

All the data were analyzed by ANOVA followed by application of LSD test at $P \leq 0.05$ using software Statistix 8.1.

RESULTS AND DISCUSSION

There was 17–18.3% incidence of late blight of potato in different field plots prior to application of fungicides. The disease incidence was continuously increased to 42, 64 and 74% in control plots after 3, 5 and 7 days of start of the experiment respectively. By contrast, in all the fungicide treatment plots, generally, there was not any significant increase in disease incidence after 3 and 5 days of spray with respect to pre-treatment data. After 7 days of spray, there was a significant increase in disease incidence in all the fungicide treatments as compared to pre-treatment data. However, at all the three-time intervals, disease incidence in fungicide treated plants was significantly lower as compared to corresponding control treatments (Figure 1). There was

53, 59 and 59% disease control after 3 days, 69, 72 and 64% after 5 days and 62, 66 and 62% after 7 days of spray due to application of cytol @ 500 g acre⁻¹, cytol @ 600 g acre⁻¹ and revus 240 mL acre⁻¹, respectively (Figure 2).

The present findings are in confirmation of Kumar *et al.* (2020) where a 100% growth inhibition of *P. infestans* was recorded at a higher concentration of 400 ppm of metalaxyl. Earlier, Humza *et al.* (2017) evaluated the antifungal potential of six different fungicides against the *P. infestans* causing infections on two strains of tomato in field conditions. The findings were in contrast to the present studies where revus was found to be the least effective one in controlling the pathogen growth. Lal *et al.* (2017) applied mancozeb 64% WP and metalaxyl at the same time before the symptom's appearance of late blight of potato followed by the onset of disease after seven days. There was a distinct difference between the spray utilization, prior to the appearance of disease symptoms that significantly affected

the pathogen incidence on potato crop. Fungicides such as cymoxanil, mancozeb 72 WP, fenamidone, dimethomorph,

difenoconazole, propineb and chlorothalonil were checked for their antifungal potential against the *P. infestans*.

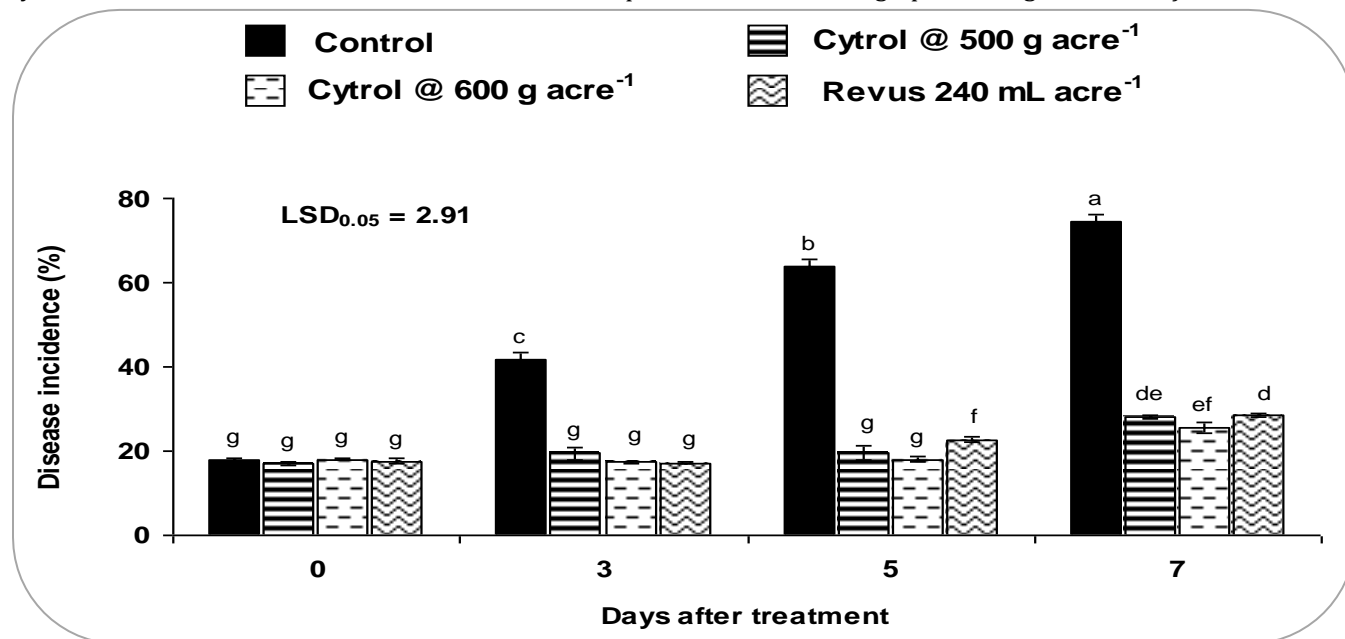


Figure 1. Effect of cytol 75% WP and revus 240 SC fungicides on incidence of late blight of potato. Vertical bars show standard errors of means of three replicates. Values with different letters at their tops show significant difference ($P \leq 0.05$) as determined by LSD test.

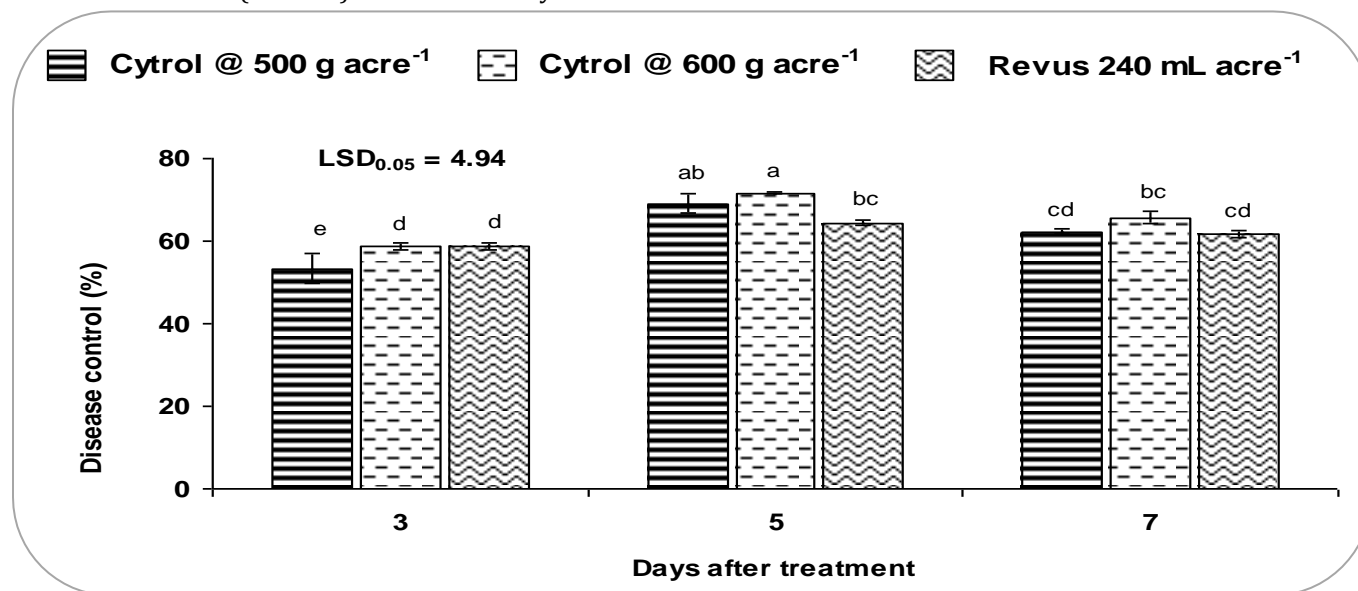


Figure 2. Percentage control of late blight of potato due to applications of cytol 75% WP and revus 240 SC fungicides. Vertical bars show standard errors of means of three replicates. Values with different letters at their tops show significant difference ($P \leq 0.05$) as determined by LSD test.

The results showed an excellent inhibitory potential of all the tested fungicides at higher concentration of 2000 µg/mL whereas, 500 and 1000 µg/mL were moderately effective and the lower concentrations of 100 and 200 µg/mL were the least effective (Peerzada *et al.*, 2020).

Previously, many studies were carried out for the effective management of potato late blight pathogen through the use of metalaxyl and mancozeb. However, a limited literature is available on the use of cytol 75% WP (thiophanate methyl 35% + chlorothalonil 40%) and

revus 240 SC (mandipropamid) against *P. infestans*. However, the applications of these two fungicides were carried out against different fungal pathogens with a successful outcome. Recently, many fungal diseases such as Alternaria blight, Alternaria leaf spot and White rust caused by *Alternaria cucumerina*, *A. brassicae* and *Albugo candida* have been controlled through the application of cytol (Asif *et al.*, 2017; Subhani *et al.*, 2018; Khan *et al.*, 2020). Likewise, Ravinder *et al.* (2020) tested three fungicides namely revus, hexaconazole and mancozeb for the effective control of *A. solani* responsible for early blight of tomato. The present study concludes that cytol and revus are very effective against the late blight pathogen *P. infestans*.

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Contribution of Authors:

Nadeem Shad	: Supervised the work and write manuscript
Irfan Liaquat	: Carried out experimental work
Iqra H. Khan	: Wrote the paper
Nisar Hussain	: Provided the research materials
Gulraze A. Liaquat	: Helped in execution of field trial
Arshad Javaid	: Prepared graphs and analyzed the data statistically