Evaluation of the efficacy of some chemical fungicides and bio fungicides for controlling early blight disease in potato under field conditions

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Abstract: Field experiments were conducted in a private farm in Menouf district, Menoufia Government to evaluate the efficacy of six chemical fungicides and three bio fungicides against potato early blight disease under field conditions during the two consecutive seasons(2017-2018 and 2018-2019) using Lady Rosetta cultivar. The chemical fungicides were {Anadol, 80% WP(mancozeb), Decent, 32.5% EC(azoxystrobin-difenoconazole), Pronto, 32% SC(azoxystrobin – tebuconazole), Ridomil Gold MZ, 68% WP(metalaxyl M-mancozeb), Score, 25% EC(difenoconazole) and Toledo, 43% SC (tebuconazole). and the bio agents were (Bio Arc, 6% WP (*Bacillus megaterium*), Bio Zeid, 2.5% WP (*Trichoderma album*)and Plant Guard (30 million cell ml^{-1}) (*Trichoderma harzianum*) }. The results showed that, in general, chemical fungicides were significantly more effective than the bio fungicides. Each fungicide and bio fungicide was applied at two rates as foliar spraying 3 times $season^{-1}$. For chemical fungicides, Decent, Score and Pronto were more effective than other chemical fungicides in reducing disease incidence and severity and subsequently increase potato tuber yields in comparison with the untreated control. Also, Bio Arc and Plant guard were more effective than Bio Zeid compound. Regardless the examined of fungicide, and as expected, the higher rate of application gave higher reduction of the potato early blight disease, and subsequently gave higher tuber yield.

Keywords: potato, early blight disease, fungicides, bio fungicides.

1.INTRODUCTION

Potato (*Solanum tuberosum* L.) is a worldwide cultivated tuber-bearing plant which is the fourth main food crop in the world after rice, maize and wheat, in terms of both cultivated area and total production **(Douches *et al.*, 1996; FAO, 2010** and **2012)**. In Egypt, potato crop has an important position among all vegetable crops, where about 20% of total area devoted for vegetable production is cultivated by potato **(Saied *et al.*, 2016)**. Potato is one of the top five consumed crops worldwide because it is common, affordable, and nutritious **(Lovat *et al.*, 2015)**. Potato plants are liable to attack by a wide range of fungal diseases. Among these diseases, early blight disease caused by *Alternaria solani* Sorauer is the most destructive disease and it occurs worldwide and is prevalent wherever potato are grown **(Pasche *et al.*, 2004)**. Foliar lesions associated with early blight lead to premature and progressive defoliation, which decreases plant photosynthetic capacity, and ultimately, reduces tuber yield. Also, Losses in commercial production potato fields can exceed 20% and losses as high as 70 to 80% have been reported in experimental field plots not treated with fungicides **(Pscheidt., 1986** and **Rotem, 1994). El-Mougy** and **Abdel-Kader (2009)** mentioned that early blight disease occurs in most production areas to almost every year and crop losses due to early blight vary enormously from 5 to 78%. On foliage, an *A. solani* characteristic symptom appears as dark, concentric rings of necrotic tissue **(Rotem, 1994)**. The new infestation was caused through the dark-colored spores and mycelia of that survive between growing seasons in infested plant debris and soil in infected potato tubers and in overwintering debris of susceptible solanaceous crops and weeds **(Saied *et al.*, 2016).** On the other side, **Kapsa (2004)** indicated that early blight disease commonly worldwide on potato crop, particularly in regions with high temperature and humidity. Early blight disease can occur over a wide range of climatic conditions and very destructive if left uncontrolled, and often resulting in a complete defoliation of plants. Also, *A. solani* which survives in infected leaf or stem tissues on or in the soil **(El-Mougy** and **Abdel-Kader., 2009; Abuley** and **Nielsen., 2019).**

Therefore, management strategies for potato early blight disease caused by *A. solani* depended on mainly on application of fungicides. Several studies have confirmed the effectiveness of fungicides for the control of this disease on potato crop. They concluded that the use of fungicides as protective / systemic fungicides can significantly reduce disease levels and increased potato tuber yield in treated versus untreated Plots **(Stevenson** and **James, 1999; Bartlett *et al.*, 2002; Stevenson** and **James, 2004; Kapsa, 2004; Pasche *et al.*, 2005; MacDonald *et al.*, 2007, Rosenzweig *et al.*, 2008; Wale *et al.*, 2008; Davidson *et al.*, 2015; Kelling *et al.*, 2016; Yellareddygari *et al.*, 2016)**.

Several researchers indicated the efficacy of bio control agents (BCAs) in controlling *A. solani* **(Abdalla *et al.*, 2014; Singh *et al.*, 2018** and **Verma *et al.*, 2018)**.

The objective of this study is to evaluate the fungicidal activity of six chemical and three bio fungicides against early blight disease on potato crop under filed condition in relation to the potato crop yield.

2.MATERIALS AND METHODS

Table (1) shows the trade and common names of used compounds.

Table (1): Some characteristics of the used compounds

Trade names	Common names	Concentrations and formulations*	Rate of application (gmor ml 100L^{-1})*
Anadol	Mancozeb	80% WP	250 - 200 gm.
Decent	Azoxystrobin - Difenoconazole	32.5% SC	300 – 200 cm^3
Pronto	Azoxystrobin - Tebuconazole	32% SC	30 - 20 cm^3
Ridomil Gold MZ	Metalaxyl M - mancozeb	68% WP	200 – 150 gm.
Score	Difenoconazole	25% EC	50 – 25 cm^3
Toledo	Tebuconazole	43% SC	35 – 20 cm^3
Bio Zeid	*Trichoderma album*	6% WP	250 – 200 gm.
Bio Arc	*Bacillus megaterium*	2.5% WP	250 – 200 gm.
Plant Guard	*Trichoderma harzianum*	30×10^6 spores/ mL^{-1}	250 – 200 gm.

*According to the recommendations of Ministry of Agriculture and Land Reclamation (2016), Agriculture pesticide committee (APC).

The field studies were carried out during the two consecutive seasons (2017-2018 and 2018-2019) in a private farm at Menouf district, Menofyia Governorate, to evaluate the effect of six fungicides and three bio fungicides (Table 1). On early blight disease (incidence and severity) of potato plants (cv. Lady Rosette) grown under field conditions. The experiments were performed under natural infections with early blight disease.

Seed piece were cut longitudinally using sterilized knife into pieces with 2-3 sprout per piece. The potato seed pieces have been disinfected before use by deceiving in a solution of sodium hypochlorite solution (10%) for 10 min and rinsing twice with sterile distilled water. Disinfected potato seed pieces was air dried for 24 h under shadow place. Then, seed tuber pieces were planting in loamy clay well drained soil to a depth of 10 cm. In addition, irrigation and nutrients such as phosphorus, nitrogen and potassium were added to ensure adequate plants nutrition during mid-growth and tuberization as recommended, according to **Saied *et al.* (2016)**. In growing seasons, the six fungicides and three biological control (BCAs) were applied at two rates (Table 1) with knapsack sprayer (CP_3) in 200 l. water feddan^{-1}. These treatments were applied 3 times from mid-February to last March in both seasons. The interval between first, second and third applications were 15-16 days depending on suitable spraying conditions. The potato seed piece was sown in each hole (8 raw, 32 hale). There experiments were designed as a randomized complete block design (RCBD) with three replicates for each treatment. The area was 21 m^2 (1 / 200 feddan, 3 × 7m.). Potato tubers cv. Lady Rosetta was planted in all treatments in December 25 and 26 of the two tested successive seasons 2017 - 2018 and 2018 - 2019, respectively.

2.1.Disease assessment:

Early blight incidence was estimated as the number of infected plants showing disease symptoms in relation to the whole number of potato plants. The average of records of the surveyed replicates for each particular treatment was calculated. Disease severity was estimated following the scale from 0 to 4 suggested by **Cohen *et al.*(1991).**as follows:

0 = no leaf lesion; 1 = lesions occupied < 25% of leaf area; 2 = lesions occupy between 26–50% of leaf area; 3 = lesions occupy between 51–75% of leaf area and 4 = lesions occupy 76 up to 100% of leaf area. Then the following formula was applied:

D.S. =$\sum$(n×c)/N

Where:

D.S. = disease severity, n = number of infected plants per category, c = category number and N = total number of examined plants.

Final the results were calculated as follow:-

1. Incidence =25 leaves / 5 plants / each replicate.
2. Disease severity (**Cohen *et al.*, 1991**).
3. Tubers yield (kg plot^{-1})
4. YOC% = C - T / C ×100

Where:

T = Treatment, C = Control.

2.2.Statistical analysis:

All data in the present study were analyzed with the analysis of variance (ANOVA) and means were separated with the least significant

differences (LSD) test at *p*= 0.01 and *p*= 0.05 according to **Gomez** and **Gomez (1984)**.

3.Results and Discussion

Field study were performed during two consecutive growing seasons (2017-2018 and 2018-2019) on potato cultivar (cv. Lady Rosetta) to study the efficacy of six chemical fungicides and three bio fungicides (BCAs) at two rates (table, 1) on potato early blight disease incidence and severity in relation to potato tuber yield.

3.1. Effect of treatments on disease incidence:

The results in Table (2) showed the effect of chemical and biological treatments on disease incidence (mean number of infected leaves, reduction % in the disease incidence). Generally, all treatments, at any rate of application in both seasons, were reduced the number of infected leaves with disease compared with the untreated treatment. Also, the chemical treatments were significantly better than the biological treatments. This is true in both seasons. In (Table, 2) when the rate of application increased, the number of infected leaves was reduced in the two seasons, and the response was varied between years. This may be due to the environmental conditions, such as temperature and rain during both seasons. The results in Table (2) indicated that at the higher recommended rate (rate 1). Decent fungicide ≥ Score ≥ Pronto ≥ Ridomil Gold MZ = Toledo ≥ Anadol ≥ Bio Arc ≥ Plant guard ≥ Bio Zeid, respectively.

At lower rate (rate2), these treatments showed that Decent ≥ Score ≥ Pronto ≥ Toledo ≥ Anadol = Ridomil Gold MZ ≥ Plant guard ≥Bio Arc≥ Bio Zeid. These results indicated that Decent fungicide was the most effective chemical fungicide followed by Score and Pronto, Ridomil Gold MZ, Toledo and Anadol. In second order the Bio agents was the least effective in comparison with the chemical fungicides. Plant guard, and Bio Arc were most effective than Bio Zeid (*Trichoderma harzianum*, *Bacillus megaterium* and *Trichoderma album*) Similar trend of results was also observed (at *0.05* and *0.01*) in second seasons (table, 2). The reduction % in the first season was lower than second season and generally this was true at any rate of application, (Except Bio Arc and Plant guard and Bio Zeid).

3.2. Effect of treatments on disease severity:

The data in Table (3) indicated that In general all treatments at any rate of applications either, in first or in second seasons (2017-2018 and 2018-2019) were reduced the disease severity in comparison with the untreated control. Chemical fungicides were more effective than bio agents (table, 3) in both seasons. When the rate of application increased, the reduction % in disease severity was reduced. The effect of treatments varied between years and this may be due the environmental conditions. All treatments on the recommended higher rate were significantly better than the lower rate. At the rate (1) we observed that, Decent ≥ Score ≥ Pronto ≥ Toledo ≥ Ridomil Gold MZ ≥ Anadol ≥ Bio Arc ≥ Plant guard ≥ Bio Zeid. This true also in the rate (2). The incidence and severity in the second season were reduced in this season in comparison with the first season and this was clearly indicated that the efficacy of all treatments gave better control of this disease in comparison with the first season (except Anadol only).

3.3. Effect of treatments on tuber yield:

The data in Table (4) indicated that effect of chemical and biological treatments on potato tuber yield at harvest during the two tested seasons (2017-2018 and 2018-2019). The average potato tuber yield was recorded as kg plot^{-1} and yield over control (YOC %) was calculated. these results showed that all treatments, at any rate of applications, were significantly increased tuber yield in comparison with the untreated control. In the first and second seasons, Decent fungicide was more effective ≥ Score ≥ Pronto ≥ Toledo ≥ Ridomil Gold MZ ≥ Anadol ≥ Bio Arc ≥ Plant guard ≥ Bio Zeid at rate (1). At rate (2) Decent ≥ Pronto ≥ Score ≥ Toledo ≥ Ridomil Gold MZ ≥ Bio Arc ≥ Anadol ≥ Plant guard ≥ Bio Zeid. In the second season, at rate (1), Decent ≥ Score ≥ Pronto ≥ Toledo ≥ Ridomil Gold MZ ≥ Anadol ≥ Bio Arc ≥ Bio Zeid ≥ Plant guard, respectively. In the second season, at rate (1), Decent fungicide gave the better data and ≥ Score ≥ Pronto ≥ Toledo ≥ Ridomil Gold MZ ≥ Anadol ≥ Bio Arc ≥ Bio Zeid ≥ Plant guard and in the second season, Decent ≥ Score ≥ Pronto ≥ Toledo ≥ Ridomil Gold MZ ≥ Bio Arc ≥ Anadol ≥ Plant guard ≥ Bio Zeid. The YOC % (increase % in tuber yield) was more obvious in the second season than the first season, and this may be due to incidence and severity were lowest than in the first season (table, 4). In general speaking, chemical fungicide's gave tuber yield better than the bio agents and this may be resulted from the efficacy of these compounds on disease incidence and severity than bio agent compounds. The results listed in Tables (2, 3 and 4) are in harmony that the fungicides which gave higher reduction of disease incidence and severity was the one which expected to give higher tuber yield. A Decent fungicide was superior in this respect. These results confirm that fungicide applications reduced the incidence and severity of potato early blight disease, and the control efficacy for the disease based on the curative application of fungicides is closely related to the dosage of fungicides applied. These fungicides increased tuber yield of potato as resulted from highly effective control of these compounds on early blight disease. Also, these results suggested that, some fungicides were better than others and chemical fungicides were more effective than bio agents (BCAs). Also, the early blight disease caused by *A.*

Table (2): Effect of fungicides and bio fungicides on early blight incidence on potato (c.v. Lady Rosetta) grown during 2017 – 2018 and 2018 - 2019 seasonsunder field conditions

Rates / Treatments	No. of infected leaves (incidence)**											
	2017 - 2018 seasons						2018 - 2019 seasons					
	Rate 1	Mean±SE*	Reduction%	Rate 2	Mean±SE	Reduction%	Rate 1	Mean±SE*	Reduction%	Rate 2	Mean±SE	Reduction%
Anadol 80% WP	250gm	09.67±1.45	60.80	200gm	16.33±0.88	33.81	250gm	07.67±1.45	67.59	200gm	14.33±1.20	39.459
Decent 32.5% SC	300cm3	03.33±0.88	86.50	200cm3	13.67±0.67	44.59	300cm3	02.33±0.33	90.15	200cm3	11±0.58	53.528
Pronto 32% SC	30cm3	06.67±0.33	72.96	20cm3	14.67±1.86	40.54	30cm3	04.33±0.88	81.70	20cm3	13.00±1.15	45.078
Ridomil gold MZ 68% WP	200gm	08.67±1.76	64.86	150gm	16.33±2.85	33.81	200gm	07.00±2.08	70.42	150gm	13.33±1.86	43.684
Score 25% EC	50cm3	05.67±0.33	77.02	25cm3	14.33±0.33	41.91	50cm3	03.33±0.33	85.93	25cm3	12±0.58	49.303
Toledo 43% SC	35cm3	08.67±0.88	64.86	20cm3	16±2.08	35.14	35cm3	06.67±0.88	71.82	20cm3	14.67±1.45	38.023
Bio Arc 6% WP	250gm	12.67±1.20	48.64	200gm	18.33±0.33	25.70	250gm	13.00±1.53	45.07	200gm	15.67±0.67	33.798
Bio Zeid 2.5% WP	250gm	17.00±1.00	31.09	200gm	20.67±0.88	16.21	250gm	16.33±0.67	31.01	200gm	19.00±0.58	19.730
Plant guard 30million cell/ml	250gm	14.67±1.67	40.54	200gm	16.67±1.67	32.43	250gm	10.67±0.33	54.92	200gm	16.67±0.88	29.573
Untreated control	-	-	-	-	24.67±0.33	-	-	-	-	-	23.67±0.33	-

L.S.D at 0.01 0.050.01 0.05

T. = 03.15= 02.3502.82 = 02.11

R.= 01.41= 01.05 01.26 = 01.05

T.×R. =00.31= 00.23 00.24 = 00.18

*SE = Standard Error.

**No. of infected leaves (incidence) = these numbers resulted from 25 leaves collected randomly from 5 plants each replicat

Table (3): Effect of treatments on severity of early blight disease on potato (c.v.Lady Rosetta) during 2017 – 2018 and 2018 - 2019 seasons under field conditions

	Severity**											
	2017 - 2018 season						2018 - 2019 season					
Rates / Treatments	Rate 1	Mean±SE*	Reduction%	Rate 2	Mean±SE	Reduction%	Rate 1	Mean±SE	Reduction%	Rate 2	Mean±SE	Reduction%
Anadol 80% WP	250gm	12.33±2.19	84.78	200gm	21.8±0.20	73.09	250gm	12.00±0.58	84.35	200gm	20.33±0.33	73.48
Decent 32.5% SC	300cm3	03.33±0.88	95.89	200cm3	19.33±2.67	76.14	300cm3	2.67±0.33	96.52	200cm3	18.33±0.33	76.09
Pronto 32% SC	30cm3	06.67±0.33	91.77	20cm3	20.67±2.19	74.48	30cm3	05.67±0.33	92.60	20cm3	19.33±0.33	74.79
Ridomil gold MZ 68% WP	200gm	12.00±1.15	85.19	150gm	21.67±0.33	73.25	200gm	10.67±0.33	86.08	150gm	19.67±0.33	74.34
Score 25% EC	50cm3	05.33±0.33	93.42	25cm3	19.67±2.73	75.72	50cm3	04.67±0.33	93.91	25cm3	18.93±0.55	75.31
Toledo 43% SC	35cm3	10.00±2.08	87.65	20cm3	21.33±3.93	73.67	35cm3	09.33±0.33	87.83	20cm3	19.50±0.38	74.57
Bio Arc 6% WP	250gm	16.67±2.19	79.42	200gm	23.67±0.67	70.78	250gm	14.67±0.33	80.87	200gm	22.47±0.27	70.69
Bio Zeid 2.5% WP	250gm	20.33±0.33	74.90	200gm	33.93±1.55	58.11	250gm	19.00±0.58	75.22	200gm	33.00±0.58	56.96
Plant guard 30million cell/ml	250gm	17.07±1.45	78.93	200gm	32.67±2.85	59.67	250gm	15.67±0.33	79.56	200gm	30.67±0.33	60.00
Untreated control	-	-	-	-	81±2.69	-	-	-	-	-	76.67±0.33	-

L.S.D at 0.01, 0.05, 0.01, 0.05
Treatments (T.) = 04.85 = 03.62= 01.02 = 00.77
Rates (R.) =02.16=01.62=00.46=00.34
T.×R=00.36=00.27=00.08=00.06
*SE = Standard Error.
**Severity = according to Cohen *et al*., (1991)

Table (4): Effect of treatments on tuber yield of potato (c.v. Lady Rosetta) during 2017 – 2018 and 2018 - 2019 seasons under field conditions.

Rates / Treatment	yield weight (Kg plot^{-1})) at harvest *											
	2017 - 2018 season						2018 - 2019 season					
	Rate 1	Mean±SE**	YOC***	Rate 2	Mean±SE	YOC***	Rate 1	Mean±SE**	YOC***	Rate 2	Mean±SE**	YOC***
Anadol 80% WP	250gm	55.63±0.88	17.60	200gm	48.01±0.53	04.52	250gm	56.93±0.52	18.55	200gm	49.19±0.37	٠5.73
Decent 32.5% SC	300cm3	68.95±0.19	33.52	200cm3	64.86±0.38	29.32	300cm3	70.52±0.53	34.25	200cm3	66.46±0.58	30.23
Pronto 32% SC	30cm3	65.21±0.12	29.70	20cm3	62.70±0.29	26.89	30cm3	66.31±0.36	30.07	20cm3	64.10±1.59	27.66
Ridomil gold MZ 68% WP	200gm	59.83±0.73	23.38	150gm	49.87±0.48	08.08	200gm	61.05±0.29	24.05	150gm	51.22±0.51	9.470
Score 25% EC	50cm3	66.57±0.22	31.14	25cm3	62.60±0.42	26.77	50cm3	67.87±0.67	31.68	25cm3	64.13±1.28	27.69
Toledo 43% SC	35cm3	62.24±0.50	26.35	20cm3	52.64±0.20	12.92	35cm3	63.61±0.61	27.10	20cm3	54.00±0.74	14.13
Bio Arc 6% WP	250gm	53.58±0.25	14.45	200gm	48.16±0.54	04.82	250gm	55.23±0.29	16.04	200gm	49.28±0.51	٠5.91
Bio Zeid 2.5% WP	250gm	49.7±1.20	7.77	200gm	46.01±0.17	00.37	250gm	52.98±0.27	12.48	200gm	47.38±0.46	٠2.13
Plant guard 30million cell ml^{-1}	250gm	51.53±0.84	11.04	200gm	46.26±0.25	00.91	250gm	51.14±0.37	09.33	200gm	47.60±0.59	02.58
Untreated control	-	45.84±0.55		-	45.84±0.55	-	-	46.37±0.22		-	46.37±0.22	-

L.S.D at 0.01 0.05 at 0.01 0.05
Treatments (T.) = 01.62 = 01.21 = 01.95 = 01.19
Rates (R.) = 00.73 = 00.54 = 00.71 = 00.53
T.×R. = 00.06 = 00.05 = 00.17 = 00.13

*yield weight = average weight of all tubers in each plot (kg polt^{-1})
**SE = Standard Error.
*** Yield over control (YOC) = Increase %

solani is considered one the most destructive disease when the natural conditions is suitable.The disease is airborne pathogen which produces the dark unicellular spores of which are spread by wind rain and overhead irrigation splash. also, germ wounds (**Shtienberg *et al*., 1990**).

Foliar lesions associated with early blight disease lead to premature and progressive defoliation, which decrease plant photosynthetic capacity (**Pascheidt, 1986; Rotem, 1994**). On foliage, *A. solani* characteristic symptoms, appears as dark, concentration rings of necrotic tissue and also often occurs initially a gradual up ward progression with the canopy results in premature leaf senescence **(Rotem, 1994; Gudmestad et al, 2013)**. Similar trend of results was also observed **(El-Shikh et al., 1999; Wale et al., 2008; Olanya et al., 2009; Davidson et al., 2015; Abuley and Nielsen 2017 and 2019)**.

This disease reduced potato tuber yield losses in commercial production potato field can exceed 20% and lessees on high as 70 – 80 % have been reported in the field plots mot treated with fungicides **(Pascheidt, 1986; Rotem, 1994)**. This fungus attack leaves crop as well as summer crop **(El-Shikhet al., 1999)**, caused losses in tuber yield and quality by 20 to 30 % **(Wale et al, 2008)** similar trend was also reported by **(Olanya et al., 2009; Davidson et al., 2015; Abuley and Nielsem 2017)** and **(Leiminger and Hausladen, 2011 Abuley and Nielsen 2019)**.

Therefore, the use of fungicides as protectants (chlorothaonil and dithiocarbamates) or curative systemic fungicides (azoxystorbin, difenoconazole and tubeconazole) are effective at the initial development stage of infection **(Tomlin, 2003;Wale et al, 2008)**. The use fungicides as foliar applications is the most common and effective increase potato tuber yield **(Mantecon, 1998; 2004 a,b and 2006) and (MacDonald et al., 2007; Rosenzweig et al., 2008; a,b; Horsfield et al., 2010)**. **Davidson *et al*.(2015)** indicated that the use of fungicides can significantly reduce disease and increase potato tuber yield.Similar trend of results was also observed by **(Bartlett *et al*., 2002; Kapsa, 2004; Pasche *et al*., 2004; Stevenson and James, 2004 and Heaney *et al*., 2000)**.

On the other hand several researchers demonstrated the use of biological control (BCAs), comprises a number of fungus and 90% of such application have been preformed by different strains of Trichoderma, the antagonistic properties of which are based on the activation of multiple mechanism **(Singh et al., 2018 and Verma et al., 2007)**. demonstrated that Trichoderma spp. Is most successful bio fungicides in present agriculture as more than 60% of registered bio fungicides worldwide arrived from Trichoderma – based formulations. **Verma *et al*. (2018)** studies the effect of Trichoderma harzianum, T. viride, and Pasudomonas fluorescens against A. solani fungus. Who found that all treatments shows the antifungal activity against the pathogen T. harziaunm was most effective in disease severity followed by P. fluorescens. **Abdalla et al. (2014)** reported that Rhizosphere bacteria are one of the most potential disease biological control agents in the plant disease protections. Bacillus spp.as group offer several advantages over other bacteria for protection against pathogen samples because of their ability to form endospores and because the broad – spectrum activity of their antibiotics.

We concluded that the fungicides (Decent, Score and Pronto) were the most effective for controlling potato early blight disease than other tested fungicides and increased the potato tuber yield. Also, chemical fungicides were more effective than bio fungicides, Bio Arc, Plant guard were the more effective than Bio Zeid. These results supported the view that fungicidal treatments are essential for controlling the potato early blight disease under field conditions.

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تقييم كفاءة بعض مبيدات الفطريات الكيماوية والحيوية في مكافحة مرض الندوة المبكرة في البطاطس تحت الظروف الحقلية.

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الكلمات المفتاحية : البطاطس, مرض الندوة المبكرة, مبيدات الفطريات, المركبات الحيوية.

الملخص العربي:

تم إجراء جميع التجارب الحقلية في منطقة منوف محافظة المنوفية وذلك لتقييم فاعلية ستة من مبيدات الفطريات الكيماوية وثلاثة من المركبات الحيوية لمكافحة مرض الندوة المبكرة في البطاطس تحت الظروف الحقلية خلال موسمي ٢٠١٧ -٢٠١٨ و ٢٠١٨- ٢٠١٩ ميلادية وتم ذلك علي صنف ليدي روزيتا,بالنسبة لمبيدات الفطريات الكيماوية تم استخدام مبيد أنادول ٨٠ % WP (مسحوق قابل للبلل) و ديسنت ٣٢,٥ % SC , ريدوميل جولد أم زد ٦٨% WP و سكور ٢٥% EC و وتوليدو ٤٣% EC و وذلك بمعدلين وهما ٢٠٠ و٢٥٠ جرام , ٣٠٠ و ٢٠٠ سم٣ , ٣٠ و٢٠ سم٣ , ٢٠٠ و ١٥٠ جرام , ٥٠ و٢٥ سم٣ , ٣٥ و٢٠ سم٣ للمركبات المذكوره علي الترتيب.تم إستخدام ثلاثة من المركبات الحيوية وهي بيو أرك ٢,٥ % WP (باسيليس ميجايتريوم) , بلانت جارد ٣٠ مليون جرثومة/ مل (تريكوديرما هارزيانم) , وبيو زيد ٦ % WP (تريكوديرما البوم) وذلك علي معدلات ٢٥٠ و ٢٠٠ جرام لكل من المركبات الثلاثة.

أوضحت النتائج أن مبيدات الفطريات الكيماوية كانت أفضل في مكافحة المرض من المركبات الحيوية من حيث تأثيرها علي وجود وشدة مرض الندوة المبكرة في البطاطس وقد أدي ذلك إلي زيادة محصول درنات البطاطس عند المقارنة بالكنترول. وكان مبيد ديسنت وسكور وبرونتو أفضل مبيدات الفطريات المختبرة عند مقارنتها بالمركبات الأخري. أعطت مبيدات الفطريات الكيماوية أحسن النتائج عند مقارنتها مع المركبات الحيوية المختبرة علي أي معدل من معدلات التطبيق كما أعطي مركب بيو أرك وبلانت جارد نتائج أفضل من مركب بيو زيد.

عموماً قد بينت النتائج أن رش مبيدات الفطريات لمكافحة مرض الندوة المبكرة في البطاطس أمر أساسي لمكافحة المرض ويؤدي ذلك إلي زيادة محصول درنات البطاطس.