STM JOURNALS

Research & Reviews: Journal of
Agricultural Science and Technology

https://journals.stmjournals.com/rrjoast

ISSN: 2278-2206 (Online)
ISSN: 2349-3682 (Print)
Volume 15, Issue 1, 2026
January–April
DOI (Journal): 10.37591/RRJoAST

Research RRJoAST

Assessing the Effectiveness of New Fungicides Against Late Blight Disease of Potato (*Phytophthora infestans*)

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Abstract

An experiment was conducted in the field of the Plant Pathology Division, Regional Agricultural Research Station (RARS), Bangladesh Agricultural Research Institute (BARI), Jamalpur, Bangladesh, during the rabi season of 2024–2025 to find out the appropriate chemical fungicide to control the late blight disease of potato. The evaluation of twenty-five new fungicides from the Pesticide Technical Advisory Committee (PTAC), Bangladesh, along with standard control (Ridomil Gold MZ 68 WG) and control against late blight of potato under natural inoculum pressure. Efficacy of new fungicides ranged from 9.74–98.82% where Pimazelin 72 WP fungicide (T_2) demonstrated the lowest efficacy as highest in the Parizeb 80 WP fungicide (T_{12}) followed by Ninja 56 SC (T_{10}) (97.37%), Zam Gold 50 WP (T_{11}) (96.06%), Mix-Salin 72 WP (T21) (92.51%) and Xtramil 720 WP (T_9) (90.82%), respectively. More than 95% disease suppression was observed due to the spray with Ninja 56 SC (T_{10}), Zam Gold 50 WP (T_{11}), and Oracol 70 WP (T_{12}) fungicides. On the other hand, Xtramil 720 WP (T_9) and Mix-Salin 72 WP (T_{21}) fungicides suppressed the disease 90.82% and 92.51%, respectively. There was over 80% disease suppression because of the Dynil 70 WDG (T_{14}), Xtramil 720 WP (T_{15}), Xtramil 720 WP (T_{16}), and Akita 75 WP (T_{19}) fungicides application. Among the fungicides, Ninja 56 SC (T_{10}), Zam Gold 50 WP (T_{11}) and Oracol 70 WP (T_{12}) fungicides most effectively managed late blight disease of potato and Amagold 72 WP (T_7), Xtramil 720 WP (T_9), Ninja 56 SC (T_{10}) and Akita 75 WP (T_{19}) fungicides produced higher tuber yield (>20 t/ha). A correlation analysis among the parameters was performed accordingly. There is a strong positive association between disease severity (%) and disease occurrence (%). The efficacy of new fungicides (%), average individual tuber weight (g), cutworm-infested tuber (%), scab-infected tuber (%), and tuber yield (t/ha) are all negatively correlated with disease incidence (%). Thus, low tuber yield was achieved when late blight disease severely damaged potatoes.

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Received Date: November 14, 2025
Accepted Date: January 02, 2026
Published Date: January 30, 2026

Citation: H. Rahman, A. Akter, M.M. Rahman, M.M. Islam, R. Momotaz, T.H. Tabassum, M. Nazneen, Salma Sarker. Assessing the Effectiveness of New Fungicides Against Late Blight Disease of Potato (Phytophthora infestans). Research & Reviews: Journal of Agricultural Science and Technology. 2025; 15(1): 28–38p.

Keywords: Correlation, disease incidence, disease severity, efficacy of new fungicide, late blight disease, *Phytophthora infestans*, potato, yield (t/ha)

INTRODUCTION

Known as the "King of Vegetables," the potato is a starchy, tuberous crop that belongs to the Solanaceae family (*Solanum tuberosum* L.). It began on the South American mountains of

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southern Bolivia and Peru. It is the world's fourth-largest food crop after rice, wheat, and maize. Potatoes are an excellent source of nutritional antioxidants and minerals, such as potassium, magnesium, and phosphorus. Iron absorption is improved by high vitamin content, and high vitamin C/high iron potato types may greatly help meet daily iron and vitamin C requirements [1]. Wellman (1972) published a list of over 175 potato diseases and disorders [2]. Potato crops are susceptible to a wide range of biotic and abiotic stressors. It is also affected by several pests and pathogens, including fungi, viruses, bacteria, nematodes, and other insects, which are major obstacles to potato cultivation and cause annual production to fluctuate. Potato viruses, bacterial wilt (*Ralstonia solanacearum*), early blight (*Alternaria solani*), late blight (*Phytophthora infestans*), and other diseases pose significant obstacles in various regions. One of the biggest risks to potato growers worldwide is late blight, which is caused by *Phytophthora infestans* (Mont.) de Bary. It is among the most well-known crop pandemics in the world. The severe catastrophe known as "the Irish famine" occurred in 1845 as a result of the late spread of blight fungus to Europe, which decimated Europeans' basic foods. One of the major fungal diseases that manifests in Bangladesh each year in a severe form is the late blight of potatoes. Cool and humid weather is conducive to the development of this disease. In Bangladesh, potatoes are ranked as the country's second most significant crop. It is also associated with numerous diseases. The most significant and destructive potato disease is late blight, caused by *Phytophthora infestans*. This results in an annual yield loss of approximately 30%. If the environmental conditions for disease development are favorable, it may result in the complete loss of the crop within a short period of time after the disease first appears. One of the most important and reliable ways to manage late blight is to apply fungicides [3]. Fungicides are different mixtures of organic and inorganic compounds that can inhibit growth, kill zoosporangia/zoospores, and destroy the mycelium of the causative organism. Potato growers can control crop damage by using fungicides at the right periods and intervals during the growing season. Thus, the purpose of this study was to assess the most efficient chemical fungicide in controlling the disease.

MATERIALS AND METHODS

A field experiment was conducted in the Plant Pathology Division, Regional Agricultural Research Station (RARS), Bangladesh Agricultural Research Institute (BARI), Jamalpur, Bangladesh, during the rabi season of 2024–2025, to determine the appropriate chemical fungicide to control the late blight disease of potato. The evaluation of twenty-five new fungicides from the Pesticide Technical Advisory Committee (PTAC), along with standard control (Ridomil Gold MZ 68 WG) and control against late blight of potato under natural inoculum pressure (Table 1). Three replicates and 27 treatments were used in the Randomized Complete Block Design (RCBD) experiment. The unit plot size was 3 × 2 m, with a plant spacing of 60 × 25 cm. Each plot contained 40 plants. The planting was on 08 December 2024. Manure and fertilizers were applied as per recommendation of Tuber Crops Research Center (TCRC), BARI (Cowdung 10 t/ha, N 160 kg/ha, P 44 kg/ha, K 130 kg/ha, S 20 kg/ha, B 1.7 kg/ha, Zn 2.3 kg/ha, MgO 13.5 kg/ha). Weeding, irrigation, and other intercultural operations were performed, as required. Twenty-five different groups of new fungicides from PTAC, along with a standard control (Ridomil Gold MZ 68 WG), and control were sprayed from the onset of the disease. The crops were harvested on March 12, 2025. Data on different traits (percent disease incidence, percent disease severity, percent efficacy of new fungicides, average individual tuber weight, percent cutworm-infested tuber, percent scab-infected tuber, and tuber yield per hectare) were recorded (Table 2), and the recorded characters were statistically analyzed following the open-source program 'R' [4]. For estimation of disease severity, a 0–9 scale was used, with slight modifications of Rahman et al. [5]. The following disease severity scale was used in this study: 0 = no spot/lesion on the leaflets, 1 = 1–10%, 3 = 11–30%, 5 = 31–50%, 7 = 51–70%, 9 = 71%, and above. The following formula was used to determine disease incidence.

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

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Table 1. The name of the fungicide with its group name (a.i.) and dose.

Treatment with the fungicide name	Fungicide group name with a.i.	Dose
T_1 =Microbial biopesticide Therapi 1WP	Trichoderma Harzianum 1%	10 g/L of water
T_2 = Pimazelin 72 WP	Mancozeb 64% + Cymoxanil 8%	2 g/L of water
T_3 = Doya Zim 50 WDG	Carbendazim 50 WDG	2 g/L of water
T_4 = Lotus 72 WP	Mancozeb 64%+Metalaxyi 8%	2 g/L of water
T_5 = Mancozim 75 WP	Carbendazim 12%+Mancozeb 63%	5 g/L of water
T_6 = Cool 75	Mancozeb 63% + Carbendazim 12%	5 g/L of water
T_7 = Amagold 72 WP	Mancozeb 64%+ Metalaxyl 8%	4 g/L of water
T_8 = Mancozim 75 WP	Mancozeb 63%+ Carbendazim 12%	2 g/L of water
T_9 = Xtramil 720 WP	Mancozeb + Cymoxanil	2 g/L of water
T_{10} = Ninja 56 SC	Azoxystrobin+ Chlorothalonil 50% w/w	2 ml/L of water
T_{11} = Zam Gold 50 WP	Dimethomorph 40%+Cymoxanil 10% w/w	0.84 g/L of water
T_{12} = Oracol 70 WP	Propineb 70% WP	2 g/L of water
T_{13} = Manco-Best 80 WP	Mancozeb 80% w/w	2 g/L of water
T_{14} = Dynil 70 WDG	Cymoxanil 20%+Dimethomorph 50%	1.55 g/L of water
T_{15} = Xtramil 720 WP	Mancozeb + Cymoxanil	1.55 g/L of water
T_{16} = Xtramil 720 WP	Mancozeb + Cymoxanil	2 g/L of water
T_{17} = Parizeb 80 WP	Mancozeb 80% WP	2 g/L of water
T_{18} = Polyzeb 80 WG	Mancozeb 80%	2 g/L of water
T_{19} = Akita 75 WP	Mancozeb 63% + Carbendazim 12%	2 g/L of water
T_{20} = Lezeb 80 WP	Mancozeb 80% W/W	2 g/L of water
T_{21} = Mix-Salin 72 WP	Mancozeb 64 + Cymoxanil 8 WP	2 g/L of water
T_{22} = Dia Hydroxe 77 WP	Copper Hydroxide 77% WP	2 g/L of water
T_{23} = Shield 80 WP	Mancozeb 80% WP	2 g/L of water
T_{24} = Prince 77 WP	Copper hydroxide 77% WP	2 g/L of water
T_{25} = Niramoy 75 WP	Mancozeb 63% + Carbendazim 12%	2 g/L of water
T_{26} = Ridomil Gold MZ 68 WG	Mancozeb + Metalaxyl	2.0 g/L of water
T_{27} = Control	Water spray only	-

a.i., active ingredient

Table 2. Efficacy of new fungicides, yield, and yield contributing parameters of potato.

Treatments	Disease incidence (%)	Disease severity (%)	Efficacy of new fungicides (%)	Average individual weight of tuber (g)
T_1 =Microbial biopesticide Therapi 1WP	93.33 abc	99.33 a	11.82 e	38.37 ef
T_2 = Pimazelin 72 WP	95.00 ab	95.00 ab	9.74 e	50.33 a-f
T_3 = Doya Zim 50 WDG	91.67 abc	100.00 a	15.35 e	38.67 def
T_4 = Lotus 72 WP	59.17 bcd	66.67 a-d	51.84 d	53.33 a-e
T_5 = Mancozim 75 WP	47.50 de	55.33 cde	69.59 a-d	56.73 abc
T_6 = Cool 75	38.33 def	47.33 cde	72.09 a-d	56.13 a-d
T_7 = Amagold 72 WP	37.50 def	53.00 cde	72.61 a-d	60.43 abc
T_8 = Mancozim 75 WP	40.00 def	61.67 b-e	74.04 a-d	63.07 ab
T_9 = Xtramil 720 WP	20.83 def	31.67 de	90.82 a-d	66.77 a
T_{10} = Ninja 56 SC	10.00 ef	27.67 e	97.37 ab	60.87 abc
T_{11} = Zam Gold 50 WP	10.83 ef	33.33 de	96.06 ab	54.83 a-e
T_{12} = Oracol 70 WP	4.17 f	26.67 e	98.82 a	63.10 ab
T_{13} = Manco-Best 80 WP	35.00 def	57.33 cde	79.64 a-d	45.10 c-f
T_{14} = Dynil 70 WDG	20.00 def	48.33 cde	88.19 a-d	50.80 a-f
T_{15} = Xtramil 720 WP	46.67 def	45.00 cde	82.20 a-d	49.97 a-f

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T_{16} = Xtramil 720 WP	29.17 def	60.00 b-e	81.15 a-d	62.43 abc
T_{17} = Parizeb 80 WP	28.33 def	51.67 cde	78.28 a-d	52.93 a-e
T_{18} = Polyzeb 80 WG	43.33 def	50.00 cde	77.78 a-d	56.17 a-d
T_{19} = Akita 75 WP	29.17 def	41.67 cde	84.90 a-d	50.60 a-f
T_{20} = Lezeb 80 WP	33.33 def	56.67 cde	76.59 a-d	56.67 abc
T_{21} = Mix-Salin 72 WP	20.83 def	31.67 de	92.51 abc	55.40 a-e
T_{22} = Dia Hydroxe 77 WP	53.33 cde	71.67 abc	60.49 a-d	57.97 abc
T_{23} = Shield 80 WP	55.83 bcd	78.33 abc	55.45 cd	48.53 b-f
T_{24} = Prince 77 WP	50.00 de	78.33 abc	58.86 bcd	53.60 a-e
T_{25} = Niramoy 75 WP	40.00 def	61.00 b-e	67.28 a-d	56.77 abc
T_{26} = Ridomil Gold MZ 68 WG	55.00 bcd	68.33 a-d	59.68 bcd	50.17 a-f
T_{27} = Control	99.17 a	98.33 a	0.00 e	34.50 f
Level of significance	**	**	**	**
CV (%)	4.33	3.72	9.27	6.68
T_1 =Microbial biopesticide Therapi 1WP	1.23 ef		6.56 ab	15.58 b-e
T_2 = Pimazelin 72 WP	4.37 abc		4.10 c-g	14.52 cde
T_3 = Doya Zim 50 WDG	2.96 b-f		4.84 b-g	13.74 de
T_4 = Lotus 72 WP	2.94 b-f		3.39 fgh	16.78 a-d
T_5 = Mancozim 75 WP	3.06 b-e		4.53 c-g	18.35 a-d
T_6 = Cool 75	5.84 a		4.14 c-g	18.93 abc
T_7 = Amagold 72 WP	4.08 a-d		4.55 c-g	21.12 a
T_8 = Mancozim 75 WP	0.98 f		6.05 abc	19.53 abc
T_9 = Xtramil 720 WP	4.36 abc		5.70 a-d	20.71 a
T_{10} = Ninja 56 SC	4.83 ab		5.63 a-d	20.71 a
T_{11} = Zam Gold 50 WP	3.96 a-d		3.60 e-h	19.78 ab
T_{12} = Oracol 70 WP	3.58 bcd		4.46 c-g	19.52 abc
T_{13} = Manco-Best 80 WP	2.67 c-f		5.48 a-e	16.77 a-d
T_{14} = Dynil 70 WDG	2.81 b-f		2.99 gh	18.71 a-d
T_{15} = Xtramil 720 WP	2.24 def		3.96 d-g	17.54 a-d
T_{16} = Xtramil 720 WP	2.81 b-f		5.14 a-f	18.32 a-d
T_{17} = Parizeb 80 WP	3.74 bcd		3.73 d-h	18.27 a-d
T_{18} = Polyzeb 80 WG	2.96 b-f		4.35 c-g	18.92 abc
T_{19} = Akita 75 WP	3.08 b-e		3.88 d-g	21.00 a
T_{20} = Lezeb 80 WP	3.22 b-e		4.98 b-g	18.32 a-d
T_{21} = Mix-Salin 72 WP	4.16 a-d		5.31 a-f	18.54 a-d
T_{22} = Dia Hydroxe 77 WP	4.24 a-d		7.02 a	16.09 a-e
T_{23} = Shield 80 WP	3.18 b-e		6.64 ab	15.14 b-e
T_{24} = Prince 77 WP	3.15 b-e		4.72 b-g	18.27 a-d
T_{25} = Niramoy 75 WP	3.38 bcd		3.85 d-g	16.68 a-d
T_{26} = Ridomil Gold MZ 68 WG	2.49 c-f		1.91 h	19.50 abc
T_{27} = Control	3.55 bcd		5.73 a-d	11.43 e
Level of significance	**		**	**
CV (%)	3.12		2.46	4.19

RESULTS AND DISCUSSION

The efficacy of the new fungicides and yield contributing parameters of potato are shown in Table 2 and Figures 1 and 2. All treatments were significantly superior to the control, except for the percentage of cutworm-infested tubers and percentage of scab-infected tubers (Table 2). Significant results pertaining to the field evaluation of new fungicides for controlling the late blight disease of potato

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revealed that disease incidence ranged from 4.17 to 99.17%, where the fungicide Oracol 70 WP (T12) had the lowest disease incidence, which was the highest in control treatment. Disease severity ranged from 26.67 to 100%, where Oracol 70 WP fungicide (T_{12}) observed the lowest disease severity, as the highest in the Doya Zim 50 WDG fungicide (T_3), followed by Microbial biopesticide Therapi 1 WP fungicide (T_1) (99.33%), control treatment (98.33%) and Pimazelin 72 WP fungicide (T_2) (95%). The efficacy of the new fungicides ranged from 9.74–98.82% where the fungicide Pimazelin 72 WP fungicide (T_2) demonstrated the lowest efficacy, with the highest efficacy in the fungicide-encoded Oracol 70 WP (T_{12}), followed by Ninja 56 SC (T_{10}) (97.37%), Zam Gold 50 WP (T_{11}) (96.06%), Mix-Salin 72 WP (T_{21}) (92.51%), and Xtramil 720 WP (T_9) (90.82%) fungicides (Table 1 and Figure 1). These findings are consistent with those of Reddy et al. (2015) [6]. The average individual tuber weights varied from 34.50 to 66.77 g. The highest average individual tuber weight (66.77 g) was observed in the Xtramil 720 WP (T_9) fungicide treatment, and the lowest (34.50 g) was in the control treatment. The proportion of cutworm-infested tubers was highest (5.84%) with the Cool 75 (T_6) fungicide and lowest (0.98%) with the Mancozim 75 WP fungicide (T_8). The percentage of scab-infected tubers was the highest in the Dia Hydroxe 77 WP fungicide (T_{22}) (7.02%) and lowest in the standard control (Ridomil Gold MZ 68 WG) (T26) (1.91%). The T_7 treatment (Amagold 72 WP) produced the highest tuber yield per hectare (21.12 t), followed by the Akita 75 WP (T_{19}) (21.00 t), Xtramil 720 WP (T_9), and Ninja 56 SC (T_{10}) (20.71 t), whereas the control treatment produced the lowest yield per hectare (11.43 t), and was therefore found to be inferior to all other treatments (Table 1 and Figure 2). These results are consistent with those of Kavya (2016) [7], who conducted a field study to assess several fungicides. The study findings showed that the treatment was highly successful in controlling late blight of potatoes, with the lowest percentage of disease severity and the highest yield. In contrast, the control treatment had the highest degree of disease and the lowest yield. Similar outcomes were reported by Harisha (2017) [8]. Moreover, Stevic *et al.* (2017) [9] stated that in control (untreated) plots, the disease severity was 53.7% in 2014 and 76.3% in 2016. Tebuconazole had the highest efficacy in both years (96.3 and 99.6%, respectively), followed by boscalid (94.7 and 95.9%, respectively) and fluopyram (95.7 and 99.3%, respectively). The broad-spectrum multi-site fungicides mancozeb, chlorothalonil, copper hydroxide, and dithianon were effective against *Didymella applanata* and significantly reduced the severity of the disease compared to the untreated plots. The effectiveness of these substances ranges from 64.4–81.7%. On the other hand, azoxystrobin, pyraclostrobin, and fluazinam demonstrated extremely low efficacy (13.7–37.8%) in raspberry spur blight management.

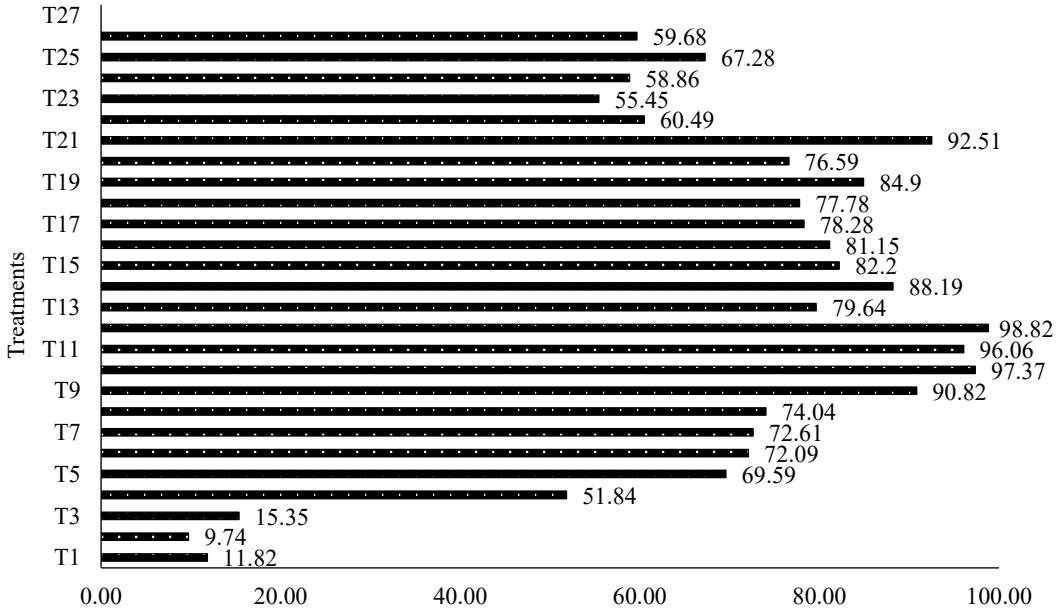

Figure 1. Efficacy (%) of different new fungicides against late blight of potato at the field level.

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Field performance of some new fungicides with control treatment in controlling late blight disease of potato is presented in pictorial form (Figure 3(a) and (b)). From Figure 3(a) and (b), it is clear that the efficacy of the different new fungicides is distinctly visible.

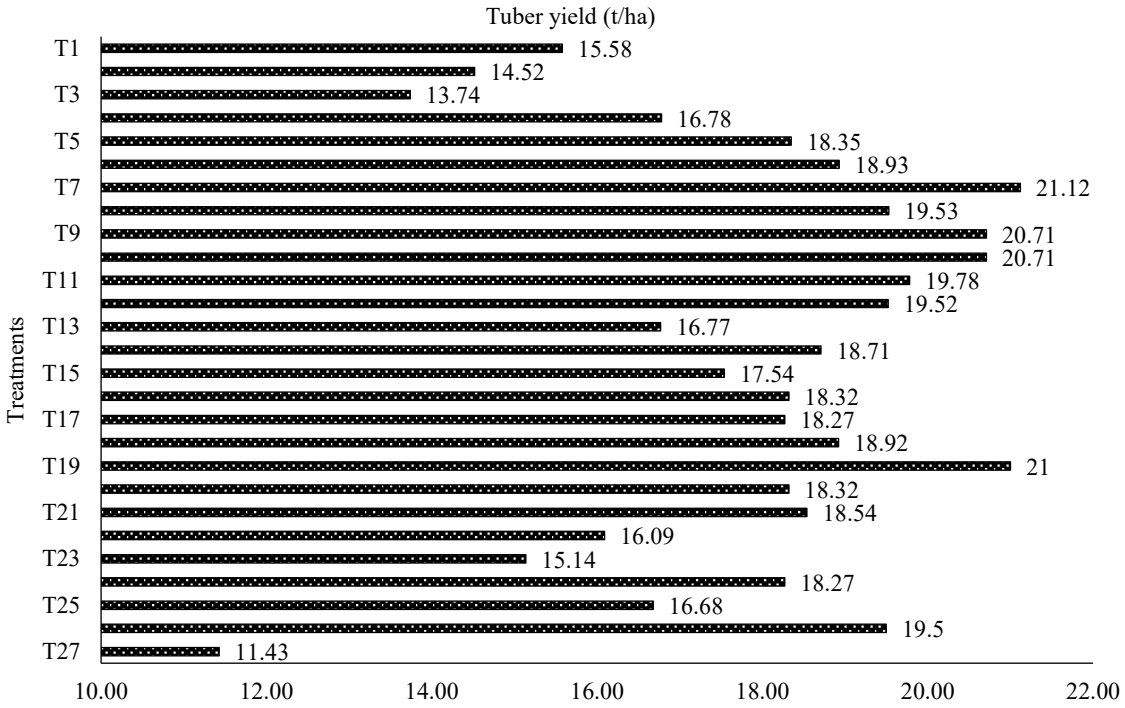

Figure 2. Effect of different new fungicides against late blight of potato on yield parameters.

Figure 3. (a) Field performance of some new fungicides with control treatment in controlling.

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Figure 3. (b) Field performance of some new fungicides with control treatment in controlling.

CORRELATION OF STUDIED PARAMETERS

The results of the study showed that there was a substantial negative and positive correlation between disease severity (%) and disease incidence (%), efficacy of different new fungicides (%), average individual weight of tuber (g), cutworm-infested tuber (%), scab-infected tuber (%), and tuber yield (t/ha) of potatoes (Figure 4). Significant positive correlations were found between late blight disease severity (%) and disease incidence (%) ($y = 1.1775x - 24.762$) and scab-infected tubers (%) ($y = 0.013x + 3.9544$). In contrast, significant negative correlations were found between late blight disease severity (%) and the efficacy of new fungicides (%) ($y = -1.2611x + 140.41$), average individual weight of tuber (g) ($y = -0.2569x + 68.486$), cutworm-infested tuber (%) ($y = -0.0162x + 4.277$), and tuber yield (t/ha) ($y = -0.0934x + 23.333$). The findings validated that the application of chemical fungicides would reduce the severity of late blight disease and thereby enhance yield, contributing to characteristics as well as the tuber yield of potato.

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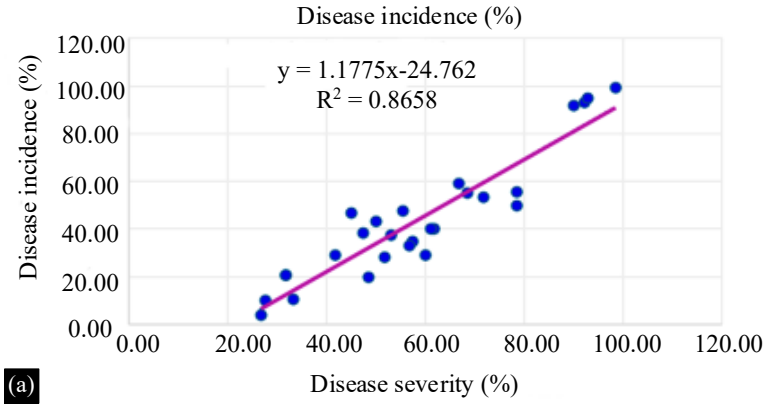

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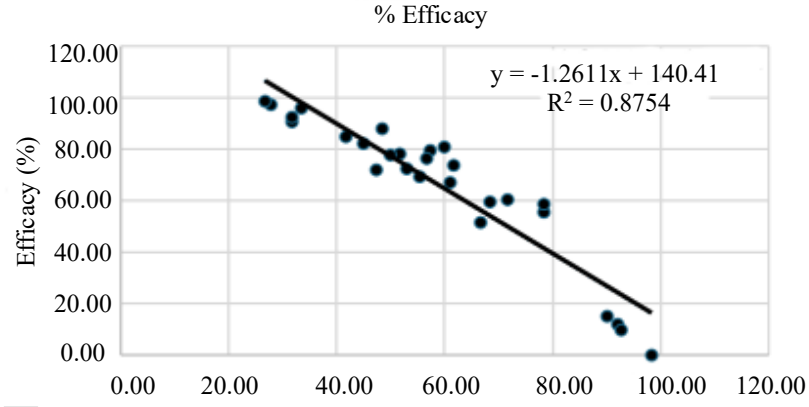

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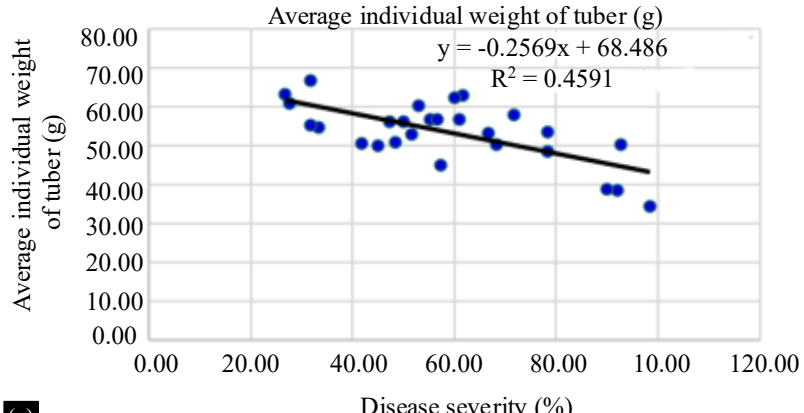

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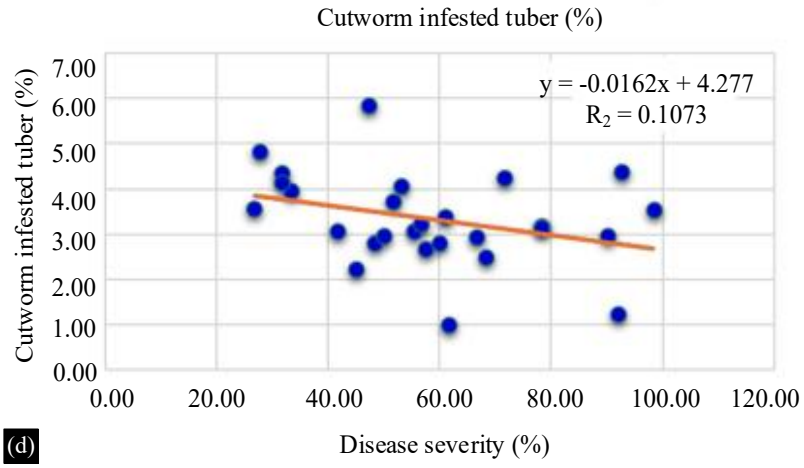

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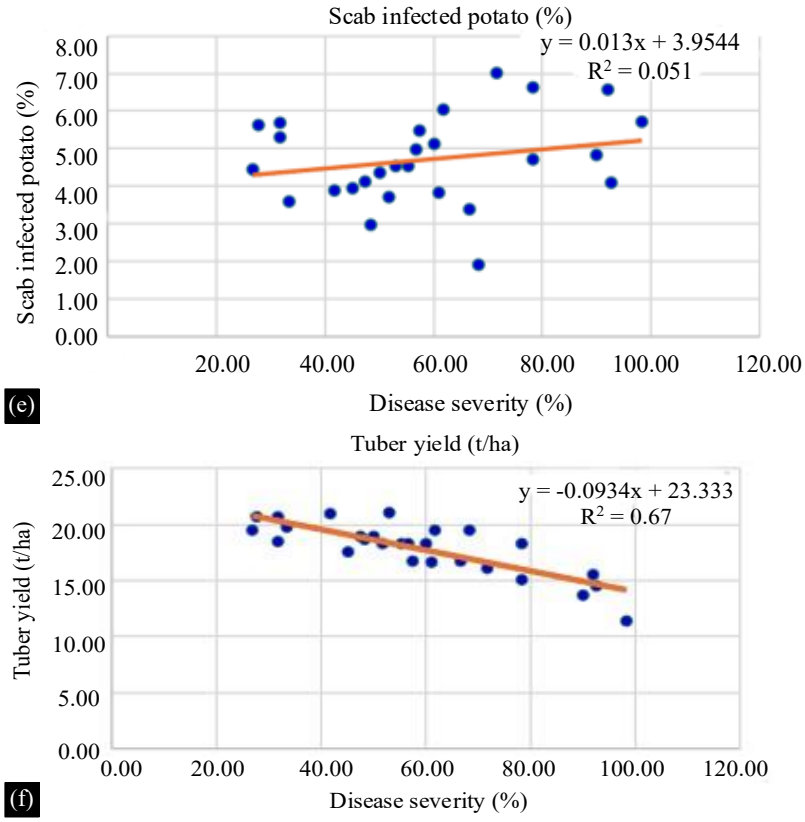

Figure 4. Correlation of disease severity (%) with disease incidence (%), efficacy (%), average individual weight of tuber (g), cutworm-infested tuber (%), scab-infected tuber (%), and tuber yield (t/ha) of potato (a–f).

CORRELATION COEFFICIENT OF STUDIED PARAMETERS

Table 3 displays the correlation coefficients calculated for the seven characteristics under investigation. The most crucial characteristic, disease incidence (%), showed a highly significant and positive correlation with disease severity (%) (0.85) and a negative correlation with the efficacy of different new fungicides (%) (–0.96), average individual weight of tuber (g) (–0.32), and tuber yield (t/ha) (–0.58). This finding indicates that high disease incidence decreases the efficacy of fungicides, lowers the average individual tuber weight, and ultimately drastically reduces tuber yield. Disease severity (%) had a strong negative correlation with the efficacy of different new fungicides (%) (–0.91), average individual weight of tubers (g) (–0.36), cutworm-infested tubers (%) (–0.17), and tuber yield (t/ha) (–0.56). Therefore, a lower tuber yield was produced with a high disease severity. The efficacy of new fungicides (%) had a strong and positive correlation with the average individual weight of tuber (g) 0.35) and tuber yield (t/ha) 0.61), whereas scab-infected tubers (%) had a significant but negative correlation (–0.22). The average individual weight of tubers (g) was significantly and positively correlated with cutworm-infested tubers (%) (0.34), scab-infected tubers (%) (0.36), and tuber yield (t/ha) (0.39). Scab-infected tubers (%) had a substantial negative correlation with tuber yield (t/ha) (–0.36). Tuber yield (t/ha) was found to be negatively and significantly linked to scab infection. Consequently, choosing one feature affects other related or pleiotropically affected attributes. Correlation studies have received a great deal of attention in the field of plant improvement because they aid in the process of making efficient choices. Table 3 shows the correlations among seven characteristics that were calculated for every possible combination at the phenotypic level in the current investigation.

The data presented in Table 3 underscores the complex physiological and pathological trade-offs in potato cultivation. The strong interrelationships between disease metrics, fungicide efficacy, and yield components highlight the necessity of an integrated management approach.

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Table 3. Correlation coefficient for different pairs of quantitative characters of 27 treatments.

Parameters	DI	DS	ENF	AIWT	CIT	SIT	TY
DI	1.00	0.85**	-0.96**	-0.32**	-0.10	0.21	-0.58**
DS		1.00	-0.91**	-0.36**	-0.17	0.19	-0.56**
ENF			1.00	0.35**	0.06	-0.22*	0.61**
AIWT				1.00	0.34**	0.36**	0.39**
CIT					1.00	0.15	-0.01
SIT						1.00	-0.36**
TY							1.00

DI = disease incidence (%), DS = disease severity (%), ENF = efficacy of new fungicides (%), AIWT = average individual weight of tuber (g), CIT = cutworm-infested tuber (%), SIT = scab-infected tuber (%), TY = tuber yield (t/ha).

Analysis of Pathological Interactions

The highly significant positive correlation between disease incidence and disease severity ($r = 0.85$) suggests that, as the pathogen spreads across the field, the intensity of the infection on individual plants accelerates proportionally. This relationship is critical because high disease pressure appears to overwhelm chemical interventions, as evidenced by the strong negative correlation with fungicide efficacy ($r = –0.96$). When disease incidence is high, the physiological load on the plant reduces its ability to respond to treatment, leading to a drastic reduction in tuber yield (r = –0.58) [10].

Yield Determinants and Quality Trade-offs

The study revealed that yield is not merely a product of plant health but a balance of multiple biotic stressors.

- *Disease severity versus yield*: The negative correlation ($r = –0.56$) confirms that severe infections lead to smaller, less marketable tubers.
- *Fungicide impact*: A positive correlation between fungicide efficacy and yield ($r = 0.61$) reinforces the economic value of effective chemical control for maintaining tuber weight [11].
- *The "weight paradox*": Interestingly, average individual tuber weight showed a positive correlation with scab infection ($r = 0.36$) and cutworm infestation ($r = 0.34$). This suggests that larger tubers have a greater surface area or longer maturation time, which increases their window of exposure to soil-borne pathogens and pests [12].

Implications for Plant Improvement

As noted in the text, these correlations provide a roadmap for "efficient choice" in breeding programs. The negative link between scab infection and tuber yield ($r = –0.36$) indicates that resistance to scab must be prioritized to prevent quality-related yield losses [13]. Because these traits may be pleiotropically linked, where one gene influences multiple traits, selection for high yield without considering disease resistance could inadvertently increase susceptibility [14].

CONCLUSION

Spraying with the following fungicides resulted in more than 80% disease suppression: Xtramil 720 WP, Ninja 56 SC, Zam Gold 50 WP, Oracol 70 WP, Dynil 70 WDG, Akita 75 WP, and Mix-Salin 72 WP. Ninja 56 SC, Zam Gold 50 WP, and Oracol 70 WP fungicides were the most effective in controlling late blight disease in potatoes and increasing tuber productivity. A correlation study was performed on these parameters. Disease incidence (%) was highly significantly and positively correlated with disease severity (%). However, there was a negative correlation between disease incidence (%) and the efficacy of new fungicides (%), average individual tuber weight (g), cutworm-infested tuber (%), scab-infected tuber (%), and tuber yield (t/ha). Therefore, a low tuber yield was obtained when potatoes were severely affected by late blight disease.

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