Seasonal Occurrence and Severity of Early Blight of Potato Caused by Alternaria solani (L.) in Relation to Weather Conditions

**Abstract**

The potato ranks third in global significance as a human food crop, trailing only rice and wheat. However, the potato plant is susceptible to fungal diseases, including Early blight, *Alternaria solani*, which can lead to significant yield losses in potato crops. The present investigation was conducted for the management of early blight of potato by using bioagents and newer fungicides*.* The experiment was conducted at experimental fields near Shri Venkateshwara University, Amroha, UP. A survey was conducted, and the daily weather data were collected from the weather station at Shri Venkateshwara University. The crop was regularly observed for the first appearance of the disease. Disease severity was recorded using a score chart consisting of a 0-9 scale. Fifty leaves were randomly selected from the field for measurement of disease severity. The results revealed that the early blight of potato disease occurred every year at Shri Venkateshwara University, Rajabpur, Amroha, UP. The first appearance of early blight was observed on 12th December 2023 with the value of 0.17 per cent at the maximum temperature 23.69, minimum temperature 2.15, and mean temperature 12.92, relative humidity 92.26%, minimum relative humidity 37.26%, mean 64.76 and 0.00 sun shine hours and maximum severity of 31.28 per cent was noted on 12. January 2024, after 32 days of the first appearance of disease at the maximum temperature 23.470C and minimum temperature 5.54, Mean 14.51 0C, relative humidity maximum 95.38 % and minimum 65.37 %, mean 80.38% and sunshine hours 6.12, evaporation 1.25 and rainfall 0.00. It was clear that the infection rate increased suddenly from 17.12.23 to 25.12.2023 and from 28.12.2023 to 11.1.2024, which might be due to the occurrence of rainfall, resulting in high relative humidity and low sunshine hours, which are optimum for the pathogens' growth. The results also showed that during second year 2024-25, the first appearance of early blight of potato *A. solani* was observed on 17th December, 2024 with the value of 0.95 per cent at the 24.670C maximum temperature and 7.58 minimum temperature, mean 16.13 per cent maximum relative humidity was 90.38 per cent, 52.57 per cent minimum and mean 71.48 relative humidity and 5.26 sun shine hours and 2.25 evaporation and the maximum disease severity of 28.54 per cent on 15 January, 2025 after 33 days first appearance of disease at maximum and minimum temperature 21.540C - 4.280C and mean 12.91 0C, maximum, minimum and mean relative humidity 94.57% – 69.54% and 82.06 % sun shine hours 5.98 and evaporation 1.39 respectively. It is clear that during 2024-25, cloud covered continuously at frequent intervals of date, but light rainfall occurred on 12th and 15th January, considering favourable conditions for the development of the disease, resulting in increased infection of the potato crop *A. solani*.

**Keywords:** Early blight, Disease severity, Weather conditions, *A. solani*., crop

**Introduction**

 Potato (*Solanum tuberosum* L., Family: Solanaceae) is one of the most important solanaceous vegetable crops, serving both local consumption and exportation globally. The potato ranks third in global significance as a human food crop, trailing only rice and wheat. There is evidence suggesting that it was likely introduced to India in the early 17th century, possibly by Portuguese traders or British missionaries (Pushkarnath, 1976). Revered as the “king of vegetables,” the potato holds a vital place in India’s vegetable markets. Thanks to its high dry matter and edible protein content, the potato stands out as a nutritionally superior vegetable and one of the world’s essential food crops (Bansode et al., 2018). It is a popular source of carbohydrates and can be used both for table consumption and for many processed products. It is used primarily to make potato flour, potato chips, frozen potatoes and potato starch (Patel et al.,2024). Uttar Pradesh is a leading state in potato production in India, playing a crucial role in the country’s agricultural sector. The top 10 potato-growing districts in Uttar Pradesh in the year 2022-23, with their production, i.e. District; Agra, Firozabad, Kannauj, Hathras, Farrukhabad, Aligarh, Badayun, Mainpuri, Barabanki, Allahabad and Barabanki 28.0, 20.8, 20.4, 19.9, 15.9, 11.0, 8.5, 7.6, 7.3, and 7.2 Lac Metric Tonnes. Nor does FAO provide insights into global potato production. The FAO’s FAOSTAT database, updated in late December 2023, includes potato production statistics up to 2022. Despite its potential for higher production, the potato crop faces challenges due to attacks from various phytopathogens, which limit its productivity. The potato plant is susceptible to fungal diseases, including Early blight, *Alternaria solani*, which can lead to significant yield losses in potato crops. Unfortunately, high temperatures and irregular rainfall are increasing the infection rate of early blight in potato plants. Consequently, the vegetative development of potato plants and yields are being affected, with yield losses of 20–54% under field conditions if early blight is not properly controlled (Meno et al.,2024)

 Reports indicate that average annual yield losses due to early blight range from approximately 50 per cent to 75 per cent of production (Murmu et al., 2017). The organism *Alternaria solani* is air-borne, soil-inhabiting and the most common disease-causing pathogen of the cultivated potato in areas with heavy dew, frequent rainfall and high humidity (Agrios, 2005). However, the excessive use of Fungicides and biocontrol agents is not desirable because of their residual effects on the food chains. Hence, there is a need for continuous evaluation of safe fungicides and biocontrol agents against disease and safety to the non-target bio-agents. Nowadays, many new emerging Fungicides and biocontrol agents are available in the market with good efficacy for disease management and safety to non-target organisms. Potato production is currently threatened by a number of biotic and abiotic factors. Among the biotic stresses, fungal diseases like late blight (*Phytophthora infestans*) and early blight (*Alternaria solani*) were the most destructive fungal diseases, which reduce the quality, quantity and market value of potato tubers (Abbas *et al*., 2013). Among the fungal diseases, early blight is one of the most destructive diseases of potato. The disease can damage both potato foliage and tubers, and in turn cause yield loss up to 5 to 50 per cent. An early blight disease is prevalent worldwide, wherever potatoes, tomatoes, peppers and eggplants are grown. Early blight is a polycyclic disease that can cause more than one disease epidemic within a single cropping season (Tsedaley, 2014). An early blight of potato is caused by two pathogens *viz*., *Alternaria solani* and *Alternaria alternata,* but in some areas, only *A. solani* is considered the causative organism of this disease, with its spores in abundance in the atmosphere and in the soil. (Iglesias *et al*., 2007). There is always a threat when conditions become conducive for infection, and thus represents a serious threat to potato production (Leiminger and Housladen 2012). Depending upon the varieties grown, weather conditions and inoculum load in the soil, this disease can cause an average annual yield loss of approximately 79 per cent of the total production of potato (Yadav *et al*., 2017). For effective management of this disease in an early stage of crop growth, there is a need for suitable management approaches to reduce the disease severity with increased tuber yield. Therefore, by considering the above factors, the present investigation was conducted for the management of early blight of potato by using bioagents and newer fungicides*.*

**Materials and Methods**

 The experiment was conducted at experimental fields near Shri Venkateshwara University (located at NH-24, Rajabpur), Amroha, UP. The study area lies between 770 42’ East longitude and 29017’ North latitude, with 237 m above mean sea level. To the study on the Seasonal incidence of Early Blight of Potato caused by *Alternaria solani* (L.) and its Disease Severity based on weather conditions during the years 2023-24 and 2024-25.

**Survey for ascertaining the prevalence and severity of the disease**

A survey was conducted at Shri Venkateshwara University (located at NH-24, Rajabpur), Amroha, Moradabad of Uttar Pradesh, during the 2023-24 and 2024-25, to find out the prevalence and intensity of early blight of potato caused by *Alternaria solani.* The weather parameters which influenced the development of the disease are also collected to correlate with weather parameters and disease intensity.

**Weather data:**

The daily weather data was collected from the weather station Shri Venkateshwara University (located at NH-24, Rajabpur), Amroha, UP.

**Observation to be recorded of disease severity:**

“The crop was regularly observed for the first appearance of the disease. The progress of the severity of the disease was also recorded daily. The observations on the date of first appearance and maximum severity per cent of each disease were recorded separately. Disease severity was recorded using a score chart consisting of a 0-9 scale” as described by Malcolimson (1976). Fifty leaves were randomly selected from the field for measurement of disease severity. “The leaves with 1-9% infection received 1, 10% infection received 2, 11-25% infection received 3, 26-40% infection received 4, 41-60% infection received 5, 61-70% infection received 6, 71-80% infection received 7, 81-90% infection received 8, 91-100% infection received 9” (Malcolimson, 1976; Kumar et al., 2017). The disease severity of individual plants was calculated by following

|  |  |  |
| --- | --- | --- |
| Ʃ | Sum of numerical rating | X 100 |
| Total number of leave x maximum rating |

Formula:

Disease severity PDI=

Correlation of disease severity with temperature, relative humidity and sunshine hours The correlation between disease severity with temperature, relative humidity and sunshine hours was calculated by standard statistical methods.

**Results and Discussion:**

**Survey and severity of early blight of potato**

 The observations on disease severity with temperature, relative humidity and sunshine hours of early blight of potato *A. Solani* observed that the disease occurs every year during *Rabi*, 2023-24 and 2024-25. Recorded data showed in (Table-1) that the first appearance of early blight was observed on 12th December 2023 with a value of 0.17 per cent at the maximum temperature 23.69, minimum temperature 2.15, and mean temperature 12.92, relative humidity 92.26%, minimum relative humidity 37.26%, mean 64.76 and 0.00 sun shine hours and maximum severity of 31.28 per cent was noted on 12. January 2024, after 32 days of the first appearance of disease at a maximum temperature 23.470C and minimum temperature 5.54, Mean 15.18 0C, relative humidity maximum 95.38 % and Minimum 65.37 %, mean 80.38% and sunshine hours 6.12, Evaporation 1.25 and rainfall 0.00 (Table 1). From the Table 1, it is clear that the infection rate is suddenly increased from 17.12.23 to 25.12.2023 and from 28.12.2023 to 11.1.2024, which might be due to the occurrence of rainfall, resulting in high relative humidity and low sunshine hours, which are optimum for the pathogens growth. Other hand results enumerated in table 2 showed that during the second year 2024-25, the first appearance of early blight of potato *A. solani* was observed on dated 17th December 2024 with a value of 0.95 per cent at the 24.670C maximum temperature and 7.58 minimum temperature, mean 16.13 per cent maximum relative humidity was 90.38 per cent, minimum relative humidity was 52.57 per centand mean 71.48 relative humidity and 5.26 sunshine hours and 2.25 evaporation and the maximum disease severity of 28.54 per cent on 15 January 2025 after 33 days the first appearance of disease at maximum and minimum temperature 21.540C - 4.280C respectively and mean 12.91 0C, maximum, minimum and mean relative humidity 94.57% – 69.54% and 82.06 % sun shine hours 5.98 and Evaporation 1.39 respectively. From Table 2, it is clear that during 2024-25, cloud covered continuously at a frequent interval of dates, but light rainfall occurred on 12th and 15th January, considering favourable conditions for the development of the disease, resulting in increased infection of the potato crop *A. solani*.

**Table:1. Seasonal incidence of early blight of Potato caused by *Alternaria solani* (L.) and its disease severity on the basis of weather conditions during 2023-24**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Date** | **Disease severity (%)** | **Temp.** | **RH. (%)** | **Sun shine** | **Evaporation** | **Rainfall** |
| **Max** | **Min** | **Mean** | **Max** | **Min** | **Mean** |  |
| 12.12.2023  | 0.17  | 23.69  | 2.15  | 12.92 | 92.26  | 37.26  | 64.76 | 0.00  | 1.21  | 0.00  |
| 13.12.2023  | 0.23  | 22.95  | 1.89  | 12.42 | 96.39 | 49.98  | 73.19 | 0.00  | 1.32  | 0.00 |
| 14.12.2023  | 0.36  | 23.59  | 4.54  | 14.06 | 93.25  | 36.87  | 65.06 | 6.59  | 1.52  | 0.00 |
| 15.12.2023  | 1.27  | 24.58  | 6.24  | 15.41 | 95.98  | 47.18  | 71.58 | 5.17  | 1.25  | 0.00 |
| 16.12.2023  | 1.95  | 25.29  | 5.17  | 15.23 | 93.29  | 46.46  | 69.88 | 7.25  | 1.00 | 3.25  |
| 17.12.2023  | 2.14  | 24.87  | 8.37  | 16.62 | 92.98  | 51.28  | 72.13 | 5.26  | 2.11  | 0.00 |
| 18.12.2023  | 2.35  | 16.87  | 15.18  | 16.02 | 96.24  | 90.15  | 93.20 | 0.00 | 1.12  | 0.00 |
| 19.12.2023  | 2.85  | 17.43 | 11.23 | 14.33 | 97.21  | 86.25  | 91.73 | 0.00 | 1.19  | 2.46  |
| 20.12.2023  | 3.97  | 21.24  | 10.79  | 16.01 | 94.12  | 73.17  | 83.65 | 0.00 | 1.65  | 0.42  |
| 21.12.2023  | 5.45  | 20.84  | 9.59  | 15.21 | 91.14  | 70.28  | 80.71 | 0.00 | 2.59  | 0.00 |
| 22.12.2023  | 6.19  | 19.68  | 9.83 | 14.75 | 96.21 | 84.18  | 90.20 | 4.26 | 1.00  | 0.00 |
| 23.12.2023  | 7.53  | 15.47 | 11.19  | 13.33 | 97.31  | 91.24  | 94.28 | 0.00 | 2.21  | 0.00 |
| 24.12.2023  | 8.69  | 18.48  | 12.38  | 15.43 | 94.29  | 78.97  | 86.63 | 0.00 | 1.10  | 4.25  |
| 25.12.2023  | 10.39  | 19.21  | 11.27  | 15.24 | 96.28  | 81.28  | 88.78 | 0.00 | 2.57  | 0.00 |
| 26.12.2023  | 11.53  | 14.78  | 10.89  | 12.83 | 93.29  | 84.69  | 88.99 | 3.12 | 1.21  | 0.00 |
| 27.12.2023  | 11.95  | 16.87 | 6.87  | 11.87 | 85.27  | 71.28  | 78.28 | 0.00 | 2.10  | 0.00 |
| 28.12.2023  | 11.69  | 17.48  | 5.63  | 11.55 | 88.69  | 79.68  | 84.19 | 1.53  | 0.81  | 0.00 |
| 29.12.2023  | 13.21  | 18.46  | 6.56  | 12.51 | 77.21  | 77.28  | 77.25 | 0.00 | 0.75  | 0.00 |
| 30.12.2023  | 15.27  | 19.47  | 6.85  | 13.16 | 83.21 | 76.69  | 79.95 | 0.00 | 0.59  | 0.00 |
| 31.12.2021  | 17.23  | 21.48  | 6.85  | 14.16 | 92.19  | 54.28  | 73.24 | 7.23  | 1.15  | 0.00 |
| 1.01.2024  | 18.96  | 22.25  | 5.58 | 13.91 | 77.28  | 42.59  | 59.94 | 6.53  | 0.48  | 0.00 |
| 2.01.2024  | 19.98  | 21.17  | 9.93  | 15.55 | 95.69  | 63.69  | 79.69 | 4.75  | 0.45  | 0.00 |
| 3.01.2024  | 21.69  | 21.98  | 10.18  | 16.08 | 96.59  | 68.46  | 82.53 | 2.13  | 0.79  | 0.00 |
| 4.01.2024  | 23.58  | 16.54  | 9.24 | 12.89 | 96.39  | 67.48  | 81.94 | 0.00 | 0.91  | 0.00 |
| 5.01.2024  | 23.98  | 17.57 | 7.98  | 12.77 | 86.24  | 65.98  | 76.11 | 0.00 | 0.79  | 0.00 |
| 6.01.2024 | 24.69  | 18.68  | 8.48 | 13.58 | 98.21 | 61.85  | 80.03 | 0.00 | 0.875 | 2.58  |
| 7.01.2024  | 26.35  | 18.48  | 5.34  | 11.91 | 84.21 | 59.21 | 71.71 | 0.00 | 0.58  | 0.00 |
| 8.01.2024  | 27.36  | 21.89 | 4.57 | 13.23 | 91.27  | 47.45  | 69.36 | 7.53  | 0.56 | 0.00 |
| 9.01.2024  | 28.76  | 22.84  | 4.65 | 13.74 | 88.26  | 82.15 | 85.21 | 8.36  | 1.54 | 0.00 |
| 10.01.2024  | 29.53  | 21.58  | 4.89  | 13.23 | 93.29  | 75.28  | 84.29 | 7.23  | 0.91 | 0.00 |
| 11.01.2024  | 30.17  | 21.84  | 7.78  | 14.81 | 95.98  | 59.89  | 77.94 | 9.18  | 1.21 | 0.00 |
| 12.01.2024  | 31.28  | 23.47  | 5.54  | 14.51 | 92.59  | 76.29  | 84.44 | 8.12  | 2.15 | 1.25  |
| 13.01.2024  | 30.24  | 20.65  | 6.47  | 13.56 | 93.97  | 72.58  | 83.28 | 6.46  | 1.22 | 0.00 |
| 14.01.2024  | 27.21  | 22.48  | 8.12  | 15.3 | 96.28  | 57.65  | 76.97 | 5.54  | 1.31 | 0.00 |
| 15.01.2024  | 25.69  | 21.64  | 5.21  | 13.42 | 95.38  | 65.37  | 80.38 | 6.12  | 1.25 | 0.00 |
| 16.01.2024  | 21.28  | 21.85  | 5.35  | 13.6 | 92.58  | 62.59  | 77.59 | 5.24  | 1.29 | 1.13  |
| 17.01.2024  | 20.17  | 22.57  | 5.48  | 14.02 | 95.87  | 55.62  | 75.75 | 6.56  | 1.42 | 0.00 |
| 18.01.2024  | 16.62  | 22.17  | 6.57  | 14.37 | 84.39  | 54.59  | 69.49 | 3.21  | 1.41 | 0.00 |
| 19.01.2024  | 15.39  | 23.21  | 8.15  | 15.68 | 81.24  | 49.64  | 65.44 | 7.24  | 1.19 | 2.21  |
| 20.01.2024  | 14.28  | 23.21  | 5.89  | 14.55 | 89.25  | 55.43  | 72.34 | 6.35  | 1.34 | 0.00 |
| 21.01.2024 | 14.98 | 22.95 | 6.29  | 14.62 | 91.54 | 67.28  | 79.41 | 7.49  | 1.20 | 0.00 |
| 22.01.2024 | 13.28 | 21.25 | 7.68  | 14.46 | 86.25  | 66.59  | 76.42 | 6.68  | 1.23 | 0.00 |
| 23.01.2024 | 13.12 | 20.14 | 4.75  | 12.44 | 93.87  | 63.56  | 64.76 | 5.57  | 1.20 | 0.00 |
| 24.01.2024 | 12.98 | 19.62 | 4.82  | 12.22 | 84.15  | 57.59  | 73.19 | 6.59  | 1.37 | 0.00 |
| 25.01.2024 | 12.31 | 18.69 | 6.38 | 12.53 | 93.27  | 47.23  | 65.06 | 5.56  | 1.65 | 0.00 |

**Table:2. Seasonal incidence of early blight of Potato caused by *Alternaria solani* (L.) and its disease severity on the basis of weather parameters during 2024-25.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Date** | **Disease severity (%)** | **Temp.** | **RH. (%)** | **Sunshine** | **Evaporation** | **Rainfall** |
| **Max** | **Min** | **Mean** | **Max** | **Min** | **Mean** |  |
| 14.12.2024 | 0.00  | 22.69  | 7.21 | 14.95 | 92.15  | 53.24  | 72.70 | 2.64 | 1.98  | 0.00 |
| 15.12.2024  | 0.00  | 23.25  | 6.28  | 14.77 | 93.65  | 49.57  | 71.61 | 1.59 | 1.67  | 0.00 |
| 16.12.2024  | 0.00  | 23.98  | 6.25  | 15.12 | 91.27  | 47.25  | 69.26 | 7.25  | 1.13 | 0.00  |
| 17.12.2024  | 0.95  | 24.67 | 7.58  | 16.13 | 90.38  | 52.57  | 71.48 | 5.26  | 2.25  | 0.00 |
| 18.12.2024  | 1.59  | 23.21  | 9.54  | 16.38 | 93.24  | 89.67  | 91.46 | 6.21 | 1.32  | 0.00 |
| 19.12.2024  | 2.35  | 23.89 | 10.35 | 17.12 | 89.35  | 88.17  | 88.76 | 4.58 | 1.49  | 1.58 |
| 20.12.2024  | 3.85  | 22.25  | 10.12  | 16.19 | 93.24  | 79.57  | 86.41 | 0.00 | 1.87  | 0.00 |
| 21.12.2024  | 5.67  | 21.65  | 9.54  | 15.60 | 91.24  | 75.47  | 83.36 | 0.00 | 2.55 | 0.00 |
| 22.12.2024  | 6.93  | 20.35  | 8.87 | 14.61 | 93.65 | 83.57  | 88.61 | 4.26 | 1.47  | 0.00 |
| 23.12.2024  | 7.87  | 19.58 | 9.58  | 14.58 | 94.28  | 85.37  | 89.83 | 0.00 | 2.65  | 0.00 |
| 24.12.2024  | 8.12  | 18.98  | 11.24  | 15.11 | 93.24  | 79.61  | 86.43 | 5.31 | 1.16  | 2.58  |
| 25.12.2024  | 9.33  | 19.47  | 12.65  | 16.06 | 95.27  | 83.21  | 89.24 | 0.00 | 2.44  | 0.00 |
| 26.12.2024  | 10.21  | 18.78  | 11.25  | 15.02 | 94.39  | 86.81  | 90.60 | 5.39 | 1.65  | 0.00 |
| 27.12.2024  | 10.89  | 16.93 | 9.25  | 13.09 | 87.24  | 70.27  | 78.76 | 0.00 | 2.65  | 0.00 |
| 28.12.2024  | 11.23  | 16.82  | 6.54  | 11.68 | 85.67  | 78.24  | 81.96 | 2.54  | 0.88  | 0.00 |
| 29.12.2024  | 12.25  | 18.57  | 5.32  | 11.95 | 81.84  | 76.54  | 79.19 | 0.00 | 0.54  | 0.00 |
| 30.12.2024  | 12.89  | 18.91  | 4.25  | 11.58 | 87.24 | 75.87  | 81.56 | 0.00 | 0.67  | 2.51 |
| 31.12.2024  | 13.18  | 20.68  | 5.98  | 13.33 | 90.28  | 63.24  | 76.76 | 6.31  | 1.55  | 0.00 |
| 1.01.2025 | 13.77  | 21.27  | 6.35 | 13.81 | 87.54  | 59.51  | 73.53 | 4.29  | 0.69  | 0.00 |
| 2.01.2025  | 15.21  | 21.88  | 8.25  | 15.07 | 92.35  | 65.74  | 79.05 | 5.21  | 1.28  | 0.00 |
| 3.01.2025  | 17.21  | 22.58  | 7.24  | 14.91 | 91.84  | 67.21  | 79.53 | 3.62  | 1.22  | 0.00 |
| 4.01.2025  | 17.73  | 21.54  | 8.21 | 14.88 | 88.57  | 63.17  | 75.87 | 1.21 | 0.97  | 0.00 |
| 5.01.2025  | 18.54  | 20.54 | 7.28  | 13.91 | 87.28  | 66.87  | 77.08 | 2.51 | 0.89  | 0.00 |
| 6.01.2025 | 19.68  | 19.54  | 6.35 | 12.95 | 92.65 | 69.43  | 81.04 | 0.00 | 0.88 | 0.00 |
| 7.01.2025  | 21.67  | 18.84  | 5.27 | 12.06 | 87.84 | 58.57 | 73.21 | 1.24 | 0.63  | 3.25 |
| 8.01.2025  | 21.89  | 20.64 | 6.21 | 13.43 | 90.28  | 59.57  | 74.93 | 6.23  | 0.54 | 0.00 |
| 9.01.2025  | 22.58  | 21.77  | 5.39 | 13.58 | 89.97  | 72.54 | 81.26 | 7.11  | 1.69 | 0.00 |
| 10.01.2025  | 22.75  | 21.65  | 4.64  | 13.15 | 92.18  | 75.22  | 83.70 | 5.37  | 0.89 | 0.00 |
| 11.01.2025  | 24.68  | 20.25  | 6.37  | 13.31 | 89.27  | 61.58  | 75.43 | 8.61  | 2.14 | 0.00 |
| 12.01.2025  | 25.68  | 21.27  | 4.21  | 12.74 | 90.58  | 63.25  | 76.92 | 7.59  | 2.98 | 0.00 |
| 13.01.2025  | 26.58  | 22.25  | 5.37  | 13.81 | 92.67  | 73.28  | 82.98 | 6.51 | 1.87 | 2.31 |
| 14.01.2025  | 27.98  | 22.84  | 7.51  | 15.18 | 93.57  | 71.84  | 82.71 | 4.21  | 1.54 | 1.50 |
| 15.01.2025  | 28.54  | 21.54 | 4.28  | 12.91 | 94.57  | 69.54  | 82.06 | 5.98  | 1.39 | 0.00 |
| 16.01.2025  | 24.25  | 22.27  | 6.27  | 14.27 | 91.87  | 63.98  | 77.93 | 3.64  | 1.33 | 0.00 |
| 17.01.2025  | 21.28  | 21.87  | 4.87  | 13.37 | 92.59  | 75.84  | 84.22 | 7.21  | 1.87 | 0.00 |
| 18.01.2025  | 15.69  | 22.54  | 6.21  | 14.38 | 83.27  | 64.51  | 73.89 | 4.23  | 1.79 | 2.65 |
| 19.01.2025  | 13.25  | 23.87  | 7.21  | 15.54 | 81.24  | 51.87  | 66.56 | 7.24  | 2.14 | 0.00 |
| 20.01.2025  | 11.25  | 23.95  | 6.27  | 15.11 | 85.13  | 56.21  | 70.67 | 8.69  | 2.57 | 0.00 |
| 21.01.2025 | 10.25 | 21.28 | 5.99  | 13.64 | 90.17 | 68.23  | 79.20 | 6.47  | 2.23 | 0.00 |
| 22.01.2025 | 8.69 | 22.67 | 6.21  | 14.44 | 88.27  | 67.51  | 77.89 | 6.53  | 2.41 | 0.00 |
| 23.01.2025 | 6.39 | 21.58 | 5.37  | 13.48 | 91.28  | 68.75  | 80.02 | 8.35  | 1.56 | 2.34 |
| 24.01.2025 | 5.28 | 20.39 | 3.27  | 11.83 | 88.49  | 59.97  | 74.23 | 7.21  | 2.10 | 3.21 |
| 25.01.2025 | 5.59 | 19.87 | 5.29 | 12.58 | 92.97  | 49.51  | 71.24 | 6.28 | 1.77 | 0.00 |
| 26.01.2025 | 5.77 | 18.24 | 3.28 | 10.76 | 89.67 | 51.47 | 70.57 | 7.21 | 2.31 | 0.00 |
| 27.01.2025 | 4.27 | 17.65 | 4.21 | 10.93 | 88.57 | 50.87 | 69.72 | 9.35 | 3.54 | 0.00 |

**Table:3.** Correlation between disease severities with temperature, RH%, Sunshine hour’s during- 2023-2024

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Disease severity(%)**  | **Temp. Max.** | **Temp. Mini.** | **R.H. Maxi.** | **R.H.Mini.** | **Sunshine** |
| **Dsp (%)** | 1 |  |  |  |  |  |
| **Temp. Max.**  | 0.131214  | 1 |  |  |  |  |
| **Temp. Mini.**  | -0.15721  | -0.33215  | 1 |  |  |  |
| **R.H. Maxi.** | -0.4159  | -0.07125  | 0.277105  | 1 |  |  |
| **R.H. Mini.** | -0.13568  | -0.57892  | 0.527994  | 0.211523  | 1 |  |
| **Sunshine** | 0.279985  | 0.621153  | -0.54715  | -0.03215  | -0.62153  | 1 |

 **Table:**4. Correlation between disease severities with temperature, RH%, Sunshine hour’s during- 2024-2025.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Disease** **severity (%)**  | **Temp.Max.** | **Temp.Mini.** | **R.H.Maxi.** | **R.H. Mini.** | **Sunshine** |
| **Dsp (%)** | 1 |  |  |  |  |  |
| **Temp.Max.**  | 0.621571  | 1 |  |  |  |  |
| **Temp.Mini.**  | -0.21325  | 0.691921  | 1 |  |  |  |
| **R.H. Maxi.** | -0.10932  | -0.21532  | -0.31210  | 1 |  |  |
| **R.H. Mini.** | -0.32159  | -0.32171  | -0.0528  | 0.457932  | 1 |  |
| **Sunshine** | 0.633439  | 0.215792  | 0.008705  | -0.29799  | -0.4325  | 1 |

**Correlation between disease severity with temperature, relative humidity and sunshine hours at:**

Shri Venkateshwara University (located at NH-24, Rajabpur), Amroha,The correlation of disease severity with temperature, relative humidity and sunshine hours at Shri Venkateshwara University, Rajabpur, Amroha, during 2023.24-2024-25 has been calculated, and the data is presented in the Tables 3 and 4. It has been found that the disease severity showed a negative correlation with temperature (0.279985), (0.621153) and a positive correlation with relative humidity (-0.54715), (-0.03215) and a partially significant and negative correlation with sunshine hours (-0.62153). During 2024-25, similar trends on the basis of observations have also been found from the Amroha judicial area. The data from the Table 4 showed that the negative correlation of disease severity with temperature (0.633439), (0.215792) positive correlation with relative humidity (0.008705),(-0.29799) and negative correlation with sunshine hours (-0.4325). Environmental factors such as temperature, wetness duration, relative humidity (moisture), sunshine hours, and rainfall affect the development of early blight on potato.

**Discussion**

 These findings are confirmed by several scientists according to works (Adams and Stevenson, 1990; Harrison *et al.,* 1965; Vloutoglou and Kalogerakis, 2000). Vander Walls *et al.*, (2001) also reported that alternating low and high humidity conditions have been shown to favour disease development. Singh (2007) reported that the disease becomes serious when the season begins with abundant moisture or frequent rains, followed by warm and dry weather. He also reported that higher mean temperatures (19.2-31.10C), frequent rains but shorter duration of relative humidity above 80%, the absence of dew during most of the season, longer photoperiod and prolonged senescence of the plants are related to low sporulation, restricted size of lesions, and moderate intensity of the disease. Troutt and Levetin (2001) also found that there was a strong positive correlation between spore concentration and temperature. The spore content in the atmosphere increases when the mean, maximum and minimum temperatures increase, making *Alternaria* a temperature-dependent fungus. Hjelmroos (1993) reported that *Alternaria* is a saprophytic genus with an optimal development shown to occur in the temperature ranges of 22–28°C. The correlation between disease severity with temperature, relative humidity and sunshine hours was calculated by standard statistical calculation and the results showed that disease severity co-relates negatively with temperature and sunshine hours, representing the value (-0.3984) and (-0.4509), respectively, but positively co-relate with relative humidity (0.5814) (Biswas *et al.,* 2013). Angulo-Romero *et al.* (1999) found that the most conidia appear in the atmosphere when minimum temperatures are over 10°C, maximum temperatures are under 30°C, and mean temperatures are between 20 and 25°C.

**Conclusion**

The result first appearance of early blight was observed on 12th December 2023 with a value of 0.17 per cent at a maximum temperature 23.69, minimum temperature 2.15, mean temperature 12.92, relative humidity 92.26%, minimum relative humidity 37.26%, mean 64.76 and 0.00 sunshine hours and maximum severity of 31.28 per cent was noted on 12. January 2024 after 32 days the first appearance of the disease at a maximum temperature 23.470C and minimum temperature 5.54, Mean 14.51 0C, relative humidity maximum 95.38 % and Minimum 65.37 %, mean 80.38% and sunshine hours 6.12, Evaporation 1.25 and rainfall 0.00, it is cleared that the infection rate is suddenly increased from 17.12.23 to 25.12.2023 and 28.12.2023 to 11.1.2024 which might be due to occurrence of rainfall, resulted in high relative humidity and low sunshine hours which are optimum for the growth of the pathogen. Other hand results enumerated in table 2 showed that during the second year 2024-25, the first appearance of early blight of potato *A. solani* was observed on dated 17th December 2024 with the value of 0.95 per cent at the 24.670C maximum temperature and 7.58 minimum temperature, mean 16.13 per cent, maximum relative humidity was 90.38 per cent, 52.57 per cent minimum and mean 71.48 relative humidity and 5.26 sunshine hours and 2.25 evaporation and the maximum disease severity of 28.54 per cent on 15 January 2025 after 33 days the first appearance of disease at maximum and minimum temperature 21.540C-4.280C respectively and mean 12.910C, maximum, minimum and mean relative humidity 94.57% - 69.54% and 82.06 % respectively, sunshine hours 5.98 and Evaporation 1.39. It is clear that during 2024-25, cloud covered continuously at frequent intervals of date, but light rainfall occurred on 12th and 15th January, considering favourable conditions for the development of the disease, resulting in increased infection of the potato crop *A. solani*.

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1.

2.

3.

**References**

1. Abbas, M. F., Naz, F. and Irshad, G. (2013). Important fungal diseases of potato and their management-A brief review, *Mycopathology*, *11*(1), 45-50.
2. Adams, S.S. and Stevenson, W.R. (1990). Water management, disease development and potato production. *Amri. Potato J.,* 67: 3-11.
3. Angulo-Romero, J. Mediavilla-Molina, A. and Domínguez-Vilches, E. (1999). Conidia of *Alternaria* in the atmosphere of the city of Córdoba, Spain in relation to meteorological parameters. *Int. J. Biometeorol.,* 43: 45–49.
4. Bansode GM, More SA, Deshmukh MR, Supe VS (2018). Efficacy of sequential sprays of different fungicides against early blight *Alternaria solani* (Ellis and Martin) in potato *Solanum tubrosum* L. International Journal of Pharmacy and Biological Sciences.; 8(1):11-15.
5. Harrison, M.D., Livingston, C.H. and Oshima, N. (1965). Epidemiology of potato early blight in Colorado: 1. Initial infection, disease development and the influence of the environmental factors. *American Potato Journal* 42: 279-291.
6. Hjelmroos, M. (1993). Relationship between airborne fungal spore presence and weather variables. *Grana.,* 32: 40–47. Malcolimson, J.F. 1976. Assessment of field resistance to late blight (*Phytophthora infestans*) in potatoes. *Trans. Br. Mycol. Soc.,* 67: 321-325.
7. Iglesias, I., Rodriguez-rajo, F. J. and Martinez, J. (2007). Evaluation of the different *Alternaria* prediction models on potato crop in a Limia (NW of Spain). *Aerobiologia*, *23*, 27-34.
8. Leiminger, J. H. and Housladen, H. (2012). Early blight control in potato using disease- orientated threshold values. *Plant Diseases, 96*, 124-130.
9. Murmu S, Dey S and Chakraborty A, (2017). Efficacy of different fungicides for management of early blight disease of potato. Journal of Applied and Natural Science, 9(1): 280–85.
10. Pushakarnath, (1976). *Potato in sub-tropical* Orient Longman, 289 pp. Singh, R.S. 2007. *Plant Dis.,* 8th ed., Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi. Pp. 169-170.
11. Troutt, C., Levetin, E. (2001). Correlation of spring spore concentrations and meteorological conditions in Tulsa, Oklahoma. *Int. J. Biometeorol.,* 45(2): 64–74.
12. Tsedaley, B. (2014). Review on early blight (*Alternaria* spp.) of potato disease and its management options, *Journal of Biology Agriculture Healthcare*, *4*(27).191-199
13. Vander Walls, J.E., Korsen, L. and Aveling, T.A.S. 2001. A review of early blight of potato. *Afr. Plant Protect,* 70: 91-102.
14. Vloutoglou, I. and Kalogerakis, S.N. (2000). Effects of inoculum concentration, wetness duration and plant age on development of early blight (*Alternaria solani*) and on shedding of leaves in tomato plants*. Plant Pathol.,* 49: 339-345.
15. Yadav, V. K., Kumar, V. and Arghya Mani (2017). Evaluation of fungicides, bio-control agents and plant extracts against early blight of potato caused by *Alternaria solani*, *International Journal of Chemical Studies*, *6*(1), 1227-1230.

Patel, J. V., Gohel, N. M., Prajapati , D., & Parmar , D. M. (2024). Effect of Weather Factors on Severity of Early Blight Incited by Alternaria solani (Ellis and Martin) Jones and Grout in Potato. *International Journal of Plant & Soil Science*, *36*(3), 69–75.

Meno, L., Abuley, I., Seijo, M. C., & Escuredo, O. (2024). Management Strategies for Early Blight in Potatoes: Assessment of the TOMCAST Model, Including the Aerobiological Risk Level and Critical Phenological Period. *Agriculture*, *14*(8), 1414.

Kumar, P., Biswas, S. K., Kumar, V., & Lal, K. (2017). Epidemiological Studies on Early Blight of Potato under Climate Change and its Co-Relation with Disease Severity. *Int. J. Curr. Microbiol. Appl. Sci*, *6*, 1725-1736..