Effect of different environmental factors increasing severity of *Alternaria* leaf blight in Carrot (*Daucus carota* L.)

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Abstract: The present study was conducted for the efficient management of *Alternaria* blight of carrot with proper prediction and forecasting of environmental parameters. For this purpose, five carrot varieties viz. Gold Mines, Red Core, Deep Red, Mah Rani and Long Red were sown under Randomized Complete Block Design with P×P 15cm and R×R was 45cm distance with three replications. Diseased samples were taken from infected field and brought to Plant Pathology lab for isolation of fungus. For isolation of *Alternaria dauci*, PDA media was used. After isolation, culture was purified and multiplied to prepare inoculum. The disease was established in healthy carrot crop after inoculation. Afterwards, characterization of environmental factors favorable for the development of *Alternaria* blight of carrot was determined. The environmental factors determined were maximum temperature, minimum temperature, relative humidity, rainfall and wind speed. The results concluded that all environmental factors significantly contributed in a positive manner to favor the increasing trend of disease incidence. With increase in one degree of maximum temperature, disease incidence increased by 1.85% on gold mine, 1.21% on red core, 0.8% on deep red, 1.31% on mah rani and 0.82% on long red. Furthermore, minimum temperature increasing at the rate of one degree, the disease incidence was increased by 1.91% on gold mine, 1.25% on red core, 0.85% on deep red, 1.43% on mah rani and 0.89% on long red. Regarding the relative humidity, every one percent increase increases the disease incidence by 0.4% on gold mine, 0.23% on red core, 0.17% on deep red, 0.34% on mah rani and 0.17% on long red. On every one millimeter increase in rainfall, the disease incidence increased by 20.4% on gold mine, 12.63% on red core, 9.09% on deep red, 16.42% on mah rani and 8.58% on long red. With every one kilometer per hour increase in wind speed, the disease incidence was increased by 4.02% on gold mine, 2.33% on red core, 1.7% on deep red, 3.4% on mah rani and 1.75% on long red.

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Key words: Daucus carota, Alternaria leaf blight (ALB), Potato dextrose agar (PDA),

1. Introduction

Carrot (Daucus carota L.) is important vegetable crop in Pakistan. It is believed that this crop was begun from the Afghanistan and its neighboring ranges before 900s (Gugino et al., 2004). Carrot is a standout amongst the most vital vegetable product that gives great dietary incentive in everywhere throughout the world (Rubatzky, 2002). The cultivated area of carrot and turnip in Pakistan is 30,225 hectares with the yearly production of 524,462 tones (FAO, 2014). It belongs to family umbelliferea. Its name is taken from a French word ″carotte″, which originated from the Latin word ″carota″ because of its long funnel shaped orange consumable root (Northolt et al., 2004). It is utilized as serving of mixed greens, steamed or bubbled in vegetables and may likewise be set up with different vegetables to get ready soup and stew (Anjum and Amjad, 2002). It contains essential nutrients like carbohydrate, protein, fiber, vitamin A, sodium and potassium (Ahmad et al., 2004). Carrot is helpful in lessening the eyes and blood illness (Pant and Manandhar, 2007). Carrot is a cool season crop and grown under the temperature scope of 10-25˚C. The ideal temperature of day and night for plant development is 25°C and 20°C, separately (Alam et al., 2004).

The seedlings of carrot bear ice and the temperature of - 7˚C however the top development is influenced by underneath 4˚C, and this serious condition will cause the death of plant. Carrot crop is influenced by bacterial, viral and parasitic diseases and Alternaria leaf blight (*Alternaria dauci*) one of the disastrous of carrot (Koike et al., 2009). This infection happens toward the end of January when temperature

is 24˚C (Farrar et al., 2004). Alternaria dauci is a seed born parasite and is a genuine risk to production of carrot yield (Rogers et al., 2011). The characteristic symptoms of this disease are the production of lesions which are green to darker in color that at long last wind up plainly necrotic following 8-10 days of contamination. Injuries show up on the leaflets and petioles of carrot plant as lesions with a yellow hallow. Leaves end up plainly yellow, crumple and become dead when 40% leaf region ends up noticeably contaminated by this pathogen. Because of these indications, rate of photosynthesis decreased which diminishes the root measure (Pryor et al, 2002). The seriousness of this illness come to 80% contingent on ecological conditions and treatment rate (Ben et al., 2001). *Alternaria dauci* is the pathogen which is commonly supported by direct to warm temperature. Time of long wetness is extremely fundamental for the germination of contagious spore on the carrot crop. At the point when temperature builds the period of wetness decreases which is required for the leaf disease. Contamination will happen in 8-12 hours of temperature range of 16-25ºC. At the point when *Alternaria dauci* will encounter this temperature go, it sporulates promptly on necrotic tissues of the carrot leaf and spore will grow in water beads and dew (Gugino et al., 2004). Disease because of *Alternaria dauci* will be built up when there will be ideal ecological conditions for the pathogen to sporulate.

The climatic conditions for the great generation of this product are 15-20˚C temperature, relative humidity >50% all through the development season and soil PH of 6, But the climatic conditions for the contamination advancement because of *Alternaria dauci* on carrot crop are 20-25˚C temperature, relative humidity >60% and soil pH of 6-6.5 (Joubert et al., 2000). Roy (1969) found that the virulence of the pathogen was higher when humidity persists for 72 hours and the intensity was decreased considerably at 48 hours and 24 hours. Weather is an important factor which may cause substantial yield losses (Harrison, 1992). Climate and weather both are important factors which makes the plants susceptible to the attack of pathogen. Weather includes temperature, rainfall, humidity, radiation, wind velocity, wind direction, cloud coverage and atmospheric pressure. These factors contribute towards the development of epiphytotic.

2. Material and Methods

Five carrot assortments named as Gold Mines, Red Core, Deep Red, Mah Rani and Long Red were taken from Vegetable Research Institute of Ayub Agricultural Research Institute, Faisalabad. These were sown under Randomized Complete Block Design with P×P distance 15cm and R×R was 45cm with three replications. Every single social practice was performed to keep the product in sound condition. Diseased samples were taken from infected field and brought to Plant Pathology lab for isolation of fungus. For isolation of *Alternaria dauci* PDA media was used. After isolation, culture was purified and multiplied to prepare inoculum for further processes. Environmental data was gathered from the agromet release of University of Agriculture, Faisalabad. The information with respect to all the ecological parameters i.e. most extreme temperature, least temperature, relative mugginess, precipitation and wind speed were gathered and subjected to relationship and relapse investigation with sickness frequency. Information with respect to the natural elements i.e. most extreme temperature, least temperature, relative stickiness, precipitation and wind speed was gotten from Agro-Met release created by Department of Agronomy, University of Agriculture, Faisalabad.

Sickness Incidence was ascertained by the accompanying recipe

Disease Incidence (%)= (Number of contaminated plants watched)/ (Total number of plants watched) ×100

The appraisal of illness was done considering the ailment rating scale created by Gugino et al. (2007). Data based on environment parameters was subjected to correlation and regression analysis.

3. Results and discussion

The experiment was done for the efficient management of *Alternaria* blight of carrot with proper prediction and forecasting of environmental parameters. The environment factors based on which the incidence of disease was assessed were maximum temperature, minimum temperature, relative humidity, rainfall and wind speed. All the varieties were evaluated on these environmental variables under field conditions.

Minimum Temperature

As shown in table 1, minimum temperature had a significant and positive relationship with disease incidence. With every one-degree increase in minimum temperature, the disease incidence was increased by 1.91% on gold mine, 1.25% on red core, 0.85% on deep red, 1.43% on mah rani and 0.89% on long red (Fig. 1.1).

Table 1 Correlation of environmental factors with *Alternaria leaf* blight incidence

Varieties	Maximum Temperature (°C)	Minimum Temperature (°C)	Relative Humidity (%)	Rainfall (mm)	Wind Speed (Km/h)
Gold Mine	0.9884* 0.0015	0.6564* 0.0289	0.5728* 0.0128	0.8855* 0.0457	0.1017* 0.0087
Red Core	0.9886* 0.0015	0.5650* 0.0321	0.4817* 0.0113	0.9357* 0.0194	0.1641* 0.0297
Deep Red	0.9820* 0.0029	0.5367* 0.0351	0.4386* 0.0462	0.8861* 0.0453	0.9462* 0.0423
Mah Rani	0.9824* 0.0028	0.6891* 0.0189	0.5872* 0.0297	0.8167* 0.0196	0.9357* 0.0505
Long Red	0.9723* 0.0055	0.7131* 0.0175	0.6404* 0.0444	0.8529* 0.0266	0.1159* 0.0258

Upper values indicated correlation coefficient and Lower values indicated level of significance at 5% probability level.
***: Significant**

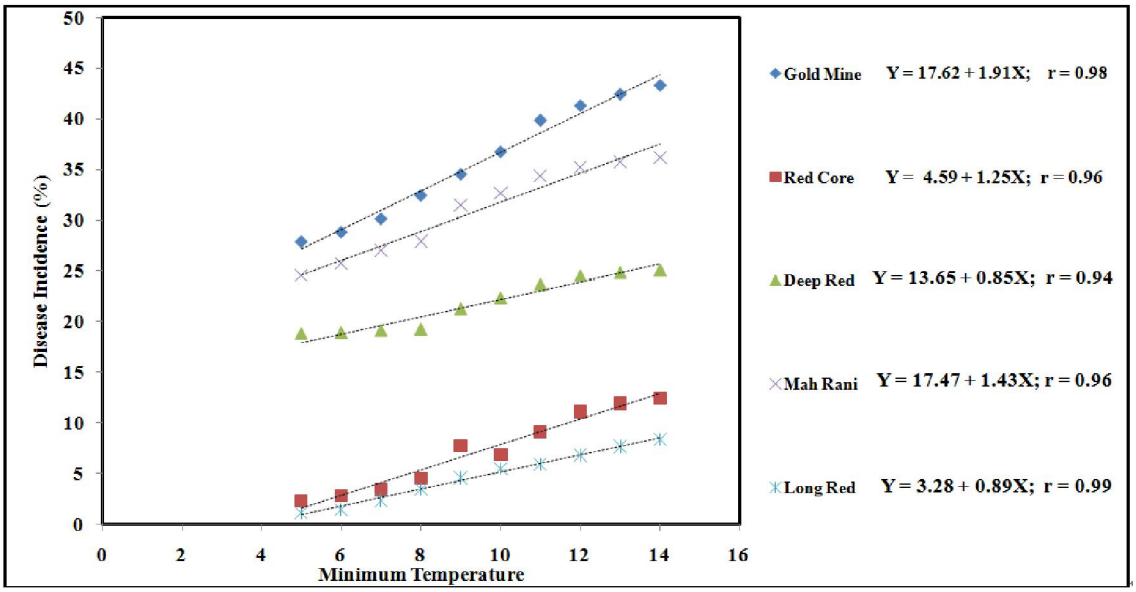

Fig. 1.1 Effect of minimum temperature on the incidence of *Alternaria dauci*

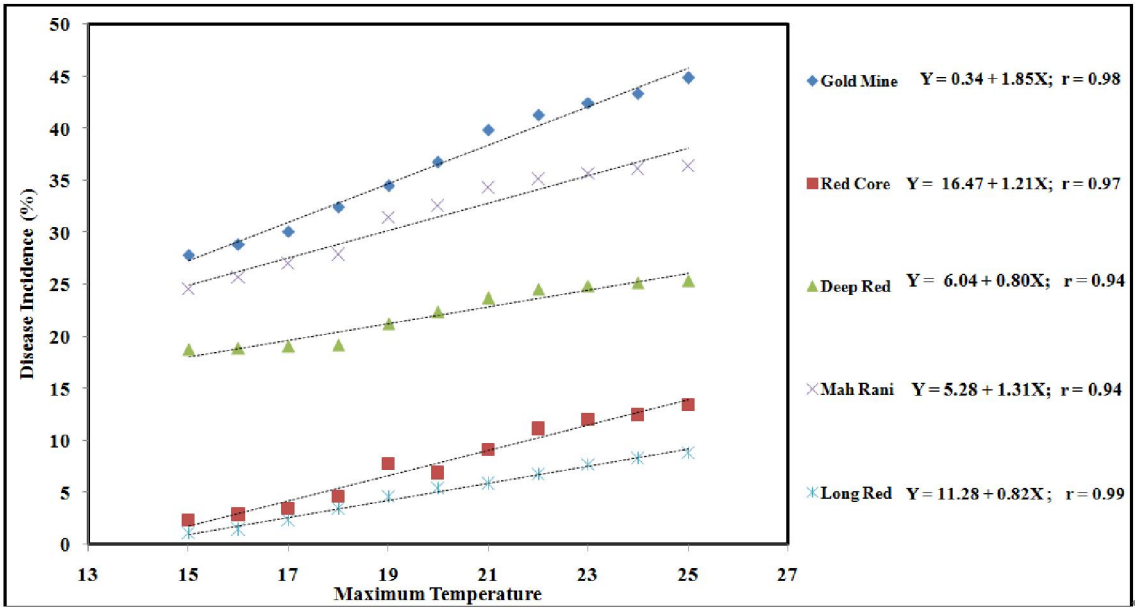

Fig. 1.2. Effect of Maximum Temperature on the incidence of Alternaria dauci

Maximum Temperature

The results concluded that disease incidence on all varieties showed positive and significant relationship with maximum temperature (Table 1). The disease incidence increased by 1.85% on gold mine, 1.21% on red core, 0.8% on deep red, 1.31% on mah rani and 0.82% on long red with every one-degree Celsius increase in maximum temperature (Fig. 1.2).

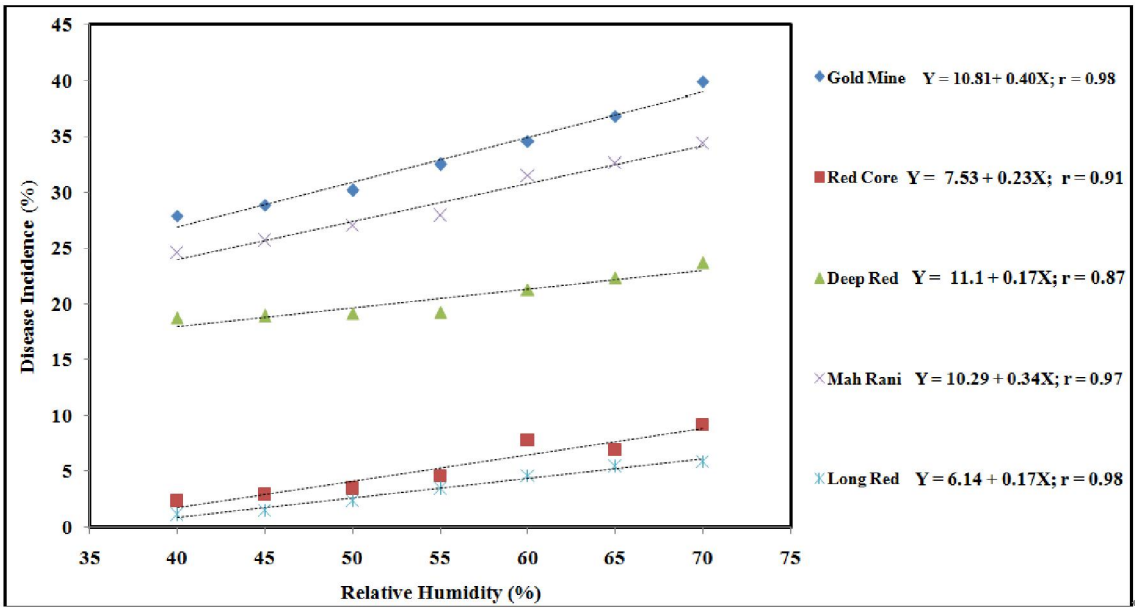

Fig. 1.3 Effect of Relative Humidity on the incidence of *Alternaria dauci*

Relative Humidity

Regarding the relative humidity, the disease incidence showed positive and significant relationship. As there is one percent increase in relative humidity, the disease incidence tends to increase by 0.4% on gold mine, 0.23% on red core, 0.17% on deep red, 0.34% on mah rani and 0.17% on long red (Fig.1.3).

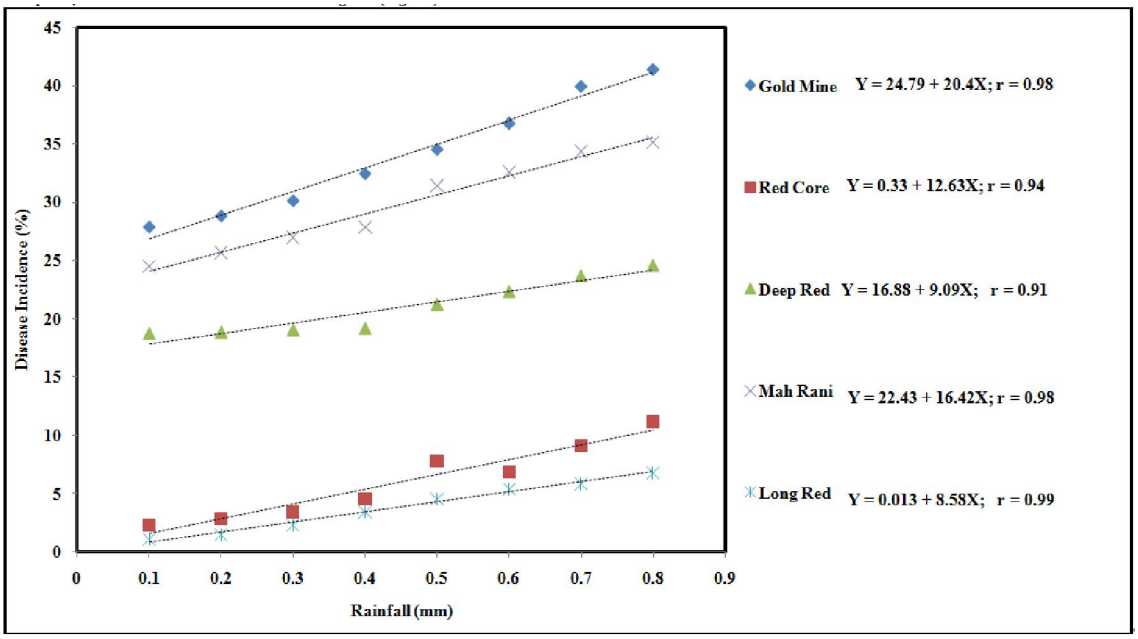

Fig. 1.4 Effect of rainfall on the incidence of *Alternaria dauci*

Rainfall

Concerning the rainfall, the disease incidence showed positive response (Table 1). On every one millimeter increase in rainfall, the disease incidence increased by 20.4% on gold mine, 12.63% on red core, 9.09% on deep red, 16.42% on mah rani and 8.58% on long red (Fig.1.4).

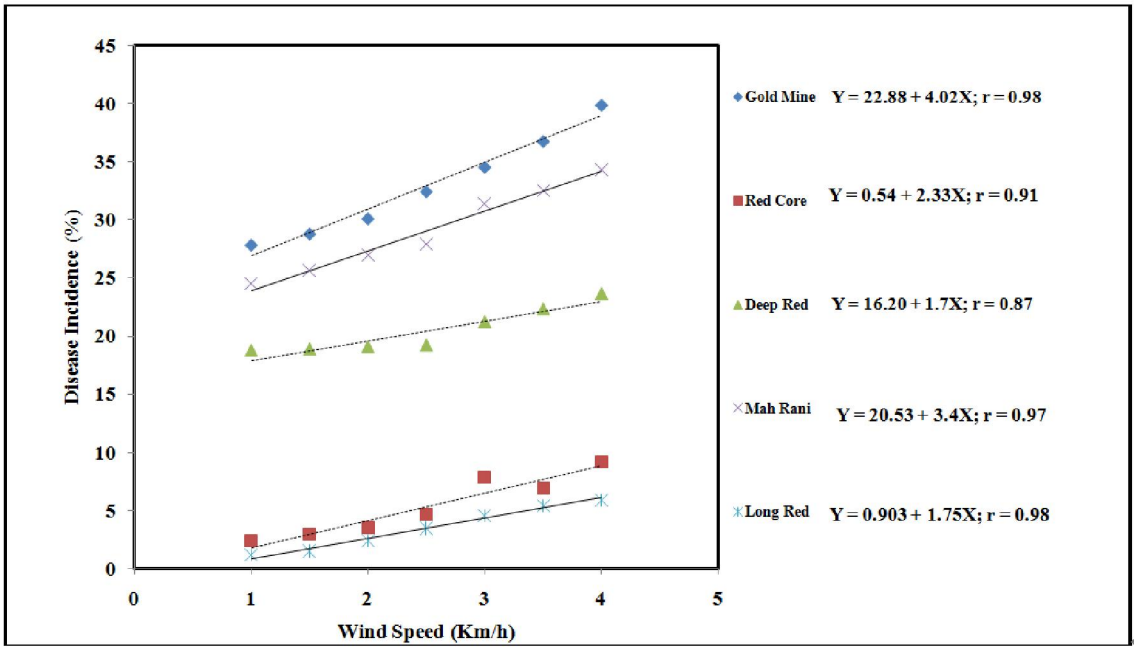

Fig. 1.5 Effect of wind speed on the incidence of *Alternaria dauci*

Wind speed

Table 1 exhibits a significant and positive correlation with disease incidence and wind speed. With every one kilometer per hour increase in wind speed, the disease incidence was increased by 4.02% on gold mine, 2.33% on red core, 1.7% on deep red, 3.4% on mah rani and 1.75% on long red (Fig.1.5).

4. Conclusion

This disease is both seed and air borne. *Alternaria dauci* is the main disease inciting agent which causes this disease. Under favorable environmental conditions, the fungus rapidly sporulates and spreads at an exponential rate. If it remains unchecked it spreads rapidly and progress to form an epidemic. So, for its appropriate management its proper forecasting of weather parameters along with integrated disease management strategy is very necessary.

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