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Effect of Meteorological Factors on Potato Early Blight Development and Infection Rates under Different Fungicidal Spray

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ABSTRACT

A field investigation entitled "Effect of effect meteorological factors on early blight development and infection rates under different fungicidal spray" was conducted during rabi season 2012-2014 on spray schedules of different fungicides for the management of early blight of potato, cultivars Kufri Bahar was sown on dated 18th November, with three replications and ten treatments in RBD design along with recommended package and practices during 2012-14 at Vegetable Farm of Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad. Maximum disease severity and AUDPC was recorded in untreated plot. The early blight disease had significant negative correlation with maximum relative humidity during 2012-13 and in year 2013-14 minimum temperature was significantly correlated. Mean infection rates showed positive but non-significant correlation with maximum and minimum temperature. The severity of early blight showed positive but non-significant correlation with maximum temperatures and sunshine hours in 2012-13 in all treatments while, it showed significant positive correlation with maximum temperature and highly significant positive correlations with sun shine hours in year 2013-14 in all treatments.

Key words: *Early blight, Alternaria solani, Infection rate, Meteorological factor and Fungicides.*

INTRODUCTION

Potato (*Solanum tuberosum* L.) is the most important food crop grown throughout the world. It is emerged as one of the most important food crops. Early blight caused by *Alternaria solani* (Ell. and Mart.) Jones and Grout is the most important disease attacking potato plants in different countries of the world. The presence of *Alternaria* spores in the atmosphere and their impact on agriculture and human health have been studied by several authors[1,5,10,12,14,15,16].

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Alternaria solani Soraeur can produce an early blight in potato crops. The only other disease that has a higher impact is the late blight caused by *Phythopthora infestans* Mont de Bary. Both pathogens can infect all aerial parts of solanaceous crops including tomato, potato, eggplant, and pepper, as well as potato tubers[3].The spores remain on the soil surface and on the leaves, and they can penetrate into the potato during harvest[13]. The life cycle of *Alternaria solani* includes soil- as well as air-borne stages, making the pathogen difficult to control by means of rotation and sanitation[4].

Early blight develops more rapidly during periods when environmental conditions alternate between humidity and drought. The attacks cause serious economic losses in potato crops [2]. Keeping in view the need of management practices with meteorological factors, the "study on early blight development and infection rates under field conditions" is undertaken with objectives: To study the effect meteorological factors on early blight development and infection rates under different fungicidal spray.

MATERIALS AND METHODS

The experiment was carried out on spray schedules of different fungicides for the management of early blight of potato, cultivars Kufri Bahar was sown on dated 18th November, with three replications and ten treatments in RBD design along with recommended package and practices during 2012-14 at Vegetable Farm of Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad. The ten treatments were *viz*: Spray with Mancozeb @ 0.25% at disease initiation stage followed by three more spray at 15 days intervals (T_1), Spray with Mancozeb @ 0.25% at disease initiation stage and 2nd spray of Fenamidone @ 0.2% followed by Mancozeb @ 0.25% at 15 days intervals (T_2), Spray with Fenamidone @ 0.2% at disease initiation stage and 2nd spray of Mancozeb @ 0.25% followed by Mancozeb @ 0.25% at 15 days intervals (T_3), Spray with Mancozeb @ 0.25% at disease initiation stage and 2nd spray of Cymoxanil @ 0.2% and 3rd spray of Mancozeb @ 0.25% at 15 days intervals (T_4), Spray with Cymoxanil @ 0.2% at disease initiation stage and 2nd spray of Mancozeb @ 0.25% followed by Mancozeb @ 0.25% at 15 days intervals (T_5) and Spray with Mancozeb @ 0.25% at disease initiation stage and 2nd spray of Dimethomorph @ 0.2% followed by Mancozeb @ 0.25% at 15 days intervals (T_6), Spray with Dimethomorph @ 0.2% at disease initiation stage and 2nd spray of Mancozeb @ 0.25% and 3rd spray of Mancozeb @ 0.25% at 15 days intervals (T_7), Spray with Mancozeb @ 0.25% at disease initiation stage and 2nd spray of Tilt @ 0.2% followed by mancozeb @ 0.25% at 15 days intervals (T_8), Spray with Tilt @ 0.2% at disease initiation stage and 2nd spray of Mancozeb @ 0.25% followed by Mancozeb @ 0.25% at 15 days intervals (T_9) and T_{10} serve as untreated.

The role of various meteorological factors on disease intensity and infection rate (unit/day) on early blight of potato was assessed during the experiment. The weather variables were temperature, relative humidity and precipitation. Development of the disease in terms of intensity was recorded periodically at seven day intervals starting from the first appearance of the disease. Weekly means of temperature, relative humidity and

precipitation that prevailed during each disease scoring date were recorded and correlated with disease development.

The observations on appearance and progression of severity of disease at weekly intervals were recorded. Data of severity were used for calculating area under disease progress curve (AUDPC). Observations on disease severity were recorded on the basis of percent leaf area affected in newer and older leaves of 10 plants selected randomly in each field using 0-5 rating scale to early blight[8].

RESULTS AND DISCUSSION

In order to ascertain the role of various meteorological factors in disease development, an attempt was made to correlate the periodic disease intensity and apparent infection rate with prevailing temperature, relative humidity (RH) and precipitation during the year 2012-14. Weekly data on mean temperature, relative humidity, precipitation and per cent disease intensity as well as apparent infection rate (unit/day) recorded are presented in the Table. In crop season 2012-13 earliest disease appeared during first week of January 2013 in control and treated plots, respectively. The per cent disease severity increased gradually till maturity and reached its maximum i.e. 8.93, 10.06, 10.50, 10.90, 11.00, 11.49, 11.50, 13.62, 16.20 and 32.50 per cent on cultivar K. Bahar in treatment third, second, fifth, fourth, seven, six, nine, eight, first and ten, respectively. Minimum infection rates 0.227 (unit per day) was recorded in treatment third while, maximum infection rates 0.725 noted on control plots. Over all the infection rates was maximum in between 4th and 5th standard week in 2013. During the higher infection rates, minimum and maximum temperature ranged between 6.05 to 8.40^{0}C and 17.40 to 22.00^{0}C, evening and morning RH ranged between 52.08-59.05 and 90.90-94.20 per cent, respectively and rainfall was occurred between 3.7-12.50 mm. Whereas, sunshine hours were ranged between 1.20 to 5.70 hours per day at that time.

In crop season 2013-14 progression of the disease severity was noted at weekly intervals. The per cent disease severity increased gradually till maturity of the crop in February and reached up to 11.50, 12.30, 14.07, 14.20, 15.00, 15.30, 15.67, 16.27, 19.63 and 38.53 per cent on cultivar K. Bahar in treatment fourth, third, second, fifth, seven, six, nine, eight, first and ten, respectively. Infection rates of disease was affected by different treatments and found minimum i.e., 0.378 unit per day in treatment third while, maximum infection rates 0.656 noted on control plots. Over all the infection rates maximum in between last and 1st standard week of 4th and 5th in 2014. During the higher infection rates minimum and maximum temperature ranged between 5.40 to 11.40 ^{0}C and 19.50 to 26.80 ^{0}C, evening and morning RH ranged between 41.40 - 68.25 and 80.40 - 90.85 per cent, respectively, whereas sunshine hours were ranged between 3.65 to 10.50 hours per day at that time. The present study is in agreement with Gupta and Paul [7] who reported that availability of abundant moisture during the growth period followed by warm and dry weather conditions are most conducive for early blight development of potato. Similar results were in agreement with Pandey and Pandey[11]; Leiminger *et al.*[9]; Grinn-Gofroń and Rapiejko[6].

Table 1: Effect of meteorological factors on early blight development in potato under different fungicidal spray (2012-13)

Dates of observation	Standard weeks	Temperature (^{0}C)		Relative humidity (%)		Rainfall (mm)	Sunshine (hrs)	Per cent disease severity on different treatments									
		Max.	Min.	Morning	Evening			T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}
04. 01.13	1	19.3	6.2	91.4	64.3	0.0	4.4	0.8	0.4	0	0	0	0.6	0	0	0	1.7
11. 01.13	2	15.5	5.9	96.4	54.4	0.0	0.4	2.79	1.5	1.4	1.63	1.4	2.13	1.9	2.5	1.9	5.8
18. 01.13	3	17.1	8.2	92.1	49.7	0.0	2.0	3.93	2.1	1.9	2.25	2	2.81	2.5	3.3	3.24	8.42
25. 01.13	4	20.7	9.5	96.4	60.9	7.4	3.1	5.2	2.7	2.5	2.93	2.7	3.5	3.21	4.9	4.48	11.2
01. 02.13	5	18.2	8.1	91.0	50.6	17.7	2.5	6.35	3.2	3.04	3.5	3.2	4.1	3.79	5.9	5.5	13.56
08. 02.13	6	22.5	10.2	93.1	61.0	0.0	7.1	9.7	4.8	4.6	5.3	5	5.91	5.6	9.13	8.8	20.9
15. 02.13	7	20.6	8.6	89.3	62.1	0.0	4.3	14.3	7.0	6.86	7.7	7.4	8.41	8.1	11.5	10.12	28.9
22. 02.13	8	23.4	8.3	92.6	55.6	0.0	5.3	16.2	10.06	8.93	10.9	10.5	11.49	11	13.62	11.5	32.5
Average		19.66	8.12	92.78	57.32	3.13	3.63										

Table 2: Effect of meteorological factors on early blight development in potato under different fungicidal spray (2013-14)

Dates of Observation	Standard weeks	Temperature (0^0C)		Relative humidity (%)		Rainfall (mm)	Sunshine (hrs)	Per cent disease severity on different treatments									
		Max.	Min.	Morning	Evening			T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}
07.01.14	2	17.8	7.1	92.0	70.6	0.5	3.4	0.9	0	0	0	0	0.8	0	0.6	0	1.3
14.01.14	3	20.9	7.9	89.7	65.9	0.2	3.9	2.6	1.6	1.3	1.6	1.5	2.3	1.8	2.3	2.4	4.3
21.01.14	4	22.6	5.5	85.6	52.7	0.0	7.3	3.7	3	2.3	2.8	2.6	3.6	3.4	3.5	3.5	7.4
28.01.14	5	23.1	5.3	87.7	58.1	0.0	6.8	6.3	5.3	4.1	4.9	5.1	6.1	6.2	6.3	6.1	9.2
04.02.14	6	22.6	6.4	83.1	64.6	2.2	5.9	8.27	6.87	6.7	7.26	7.37	8.17	7.96	8.07	7.67	11.56
11.02.14	7	24.7	9.5	83.3	55.0	0.3	5.1	10.66	9.2	8.87	9.47	9.26	10.07	9.8	9.67	9.67	14.2
18.02.14	8	27.6	10.6	82.4	43.1	0.0	7.3	14.2	12.37	11.36	12.3	12.1	13	12.87	12.9	12.67	22.67
25.02.14	9	26.1	12.2	78.4	39.7	0.0	8.6	19.63	14.07	12.3	11.5	14.2	15.3	15	16.27	15.67	38.53
Average		23.17	8.06	85.27	56.21	0.4	6.03										

Table 3: Effect of meteorological factors on infection rates of early blight of potato under different fungicidal spray (2012-13)

Standard weeks	Temperature (0^0C)		Relative humidity (%)		Rainfall (mm)	Sunshine (hrs)	Per day infection rate in different treatments										
	Max.	Min.	Morning	Evening			T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	Average
1-2	17.4	6.05	93.9	59.35	0	2.4	0	0	0	0	0	0	0	0	0	0.3485	0.034
2-3	16.3	7.05	94.2	52.05	0	1.2	0.2857	-0.0373	-0.1023	0.0119	-0.0799	0.1418	0.0820	0.2166	0.1764	0.5637	0.125
3-4	18.9	8.8	94.2	55.3	3.7	2.5	0.3986	0.1253	0.0820	0.1635	0.1186	0.2470	0.2069	0.3699	0.3397	0.6589	0.271
4-5	19.4	8.8	93.7	55.7	12.5	2.8	0.4732	0.2127	0.1877	0.2502	0.2127	0.3151	0.2836	0.4480	0.4223	0.7207	0.352
5-6	20.3	9.2	92.05	55.8	8.8	4.8	0.6092	0.3613	0.3440	0.3986	0.3745	0.4412	0.4204	0.5888	0.5755	0.8507	0.496
6-7	21.5	9.4	91.2	55.8	0	5.7	0.7343	0.5006	0.4927	0.5335	0.5193	0.5639	0.5508	0.6683	0.6293	0.9492	0.614
7-8	**22.00**	**8.40**	**90.90**	**55.08**	**0**	**4.8**	0.7763	0.6227	0.5861	0.6490	0.6368	0.6665	0.6527	0.7223	0.6700	0.9853	0.696
Average	19.4	8.24	92.87	55.58	3.57	3.45	0.468	0.255	0.227	0.286	0.254	0.339	0.313	0.430	0.401	0.725	

Table 4: Effect of meteorological factors on infection rates of early blight of potato under different fungicidal spray (2013-14)

Standard weeks	Temperature (0^0C)		Relative humidity (%)		Rainfall (mm)	Sunshine (hrs)	Per day infection rate in different treatments										
	Max.	Min.	Morning	Evening			T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	Average
2-3	19.50	7.5	90.85	68.25	0.35	3.65	0	0	0	0	0	0	0	0	0	0.1694	0.016
3-4	21.75	6.7	87.65	59.3	0.1	5.6	0.2594	0.1158	-0.0530	0.0909	0.0467	0.2380	0.1840	0.2284	0.2329	0.5133	0.185
4-5	22.80	5.4	86.65	54.4	0.0	7.05	0.4562	0.3887	0.2817	0.3584	0.3650	0.4446	0.4464	0.4531	0.4430	0.5969	0.423
5-6	22.80	5.8	85.40	61.35	1.1	6.35	0.5606	0.4983	0.4805	0.5127	0.5187	0.5560	0.5484	0.5531	0.5366	0.6700	0.543
6-7	23.65	7.95	83.20	59.8	1.25	10.50	0.6437	0.5952	0.5835	0.6053	0.5988	0.6263	0.6176	0.6139	0.6128	0.7348	0.623
7-8	26.15	10.05	82.85	49.05	0.15	6.2	0.7336	0.6902	0.6641	0.6890	0.6838	0.7065	0.7031	0.7036	0.6982	0.8750	0.714
8-9	**26.80**	**11.4**	**80.40**	**41.4**	**0.0**	**7.95**	0.8328	0.7329	0.6918	0.6728	0.7354	0.7584	0.7524	0.7765	0.7651	1.0332	0.775
Average	23.35	7.82	85.28	56.22	0.42	6.75	0.498	0.431	0.378	0.418	0.4212	0.475	0.464	0.475	0.469	0.656	

CONCLUSION

It can be concluded that the severity of early blight showed positive but non-significant correlation with maximum temperatures and sunshine hours, while, it showed significant positive correlation with maximum temperature and highly significant positive correlations with sun shine hours in all treatments. Mean infection rates showed positive but non-significant correlation with maximum and minimum temperatures. The present studies give us an insight into the status of early blight of potato in Eastern Uttar Pradesh, infection rates to early blight and its progression and development in relation to different weather variables.

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