

Aerobiology and epidemiology of Late Blight of potato in surrounding areas of Imphal in Manipur

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Potato (*Solanum tuberosum* L) is an important vegetable crop of Manipur which belongs to the family Solanaceae. The Airspora over a potato plantation field in surrounding areas of Imphal was carried out for two crop seasons, November 2010 to March 2011 and November 2011 to March 2012 by employing Rotorod air sampler. Analysis of the airspora over the crop field revealed thirty spore types. Deuteromycotina dominated the fungull airspora over the potato field during the investigation period. *Phytophthora infestans* (Mont) De Bary is the casual organism of Late Blight disease of potato. The disease affects leaves stems and tubers. A total of 30 spore types belonging to 5 different sub-divisions of fungi were found from the potato field. The symptoms of Late blight disease of potato was noted first on foliage of the test crop on January for both the crop seasons. The period of maximum incidence of spore and disease was coincided with vegetation and tuberization phases of the crop.

Key words: Air borne, spore, *Phytophthora infestans*, potato field

INTRODUCTION

The Late blight is one of the destructive diseases of potato. It is the most serious of all the potato diseases when conditions are favourable for its spread. The famous Irish famine of 1845-46 was due largely to the failure of potato crop, due to Late blight infection. In India, the disease was first introduced into the Nilgiri hills between 1870 and 1880 and very soon it spreads to Darjeeling in the Himalayan ranges. The first severe outbreaks of the disease were reported between 1912 and 1928 from Assam, Bengal and Bihar.

In northern India, the disease was first reported from the plains of western U.P. Potato is cultivated

in the state as *rabi* crop during winter season. Potato is susceptible to a number of diseases, some of which are widespread and others are localized. The causal agents of these diseases include bacteria, fungi, viruses, mycoplasmas, viroids and nematodes. Majority of plant pathogens which causes disease are air borne. In Manipur, Late blight diseases of potato causes considerable damage to the crop thereby causing huge losses to the cultivators.

Aerobiological approaches to late blight disease of potato are necessary for obtaining reliable information for the occurrence of potato disease. Therefore, Investigations have been undertaken with the following objectives:

To investigate the contribution of pathogenic fungal spore over the potato field, and to correlate the effect of weather parameters on the prevalence of pathogenic fungal spore over the test field.

MATERIALS AND METHODS

Potato (*Solanum tuberosum* L.) cultivar kufri jyoti was grown in about one hectare area in the local farmer's field in Imphal (24°44'N latitude and 93°38'E longitude). Air sampling was carried out by operating rotorod air sampler kept on the ground level with its lower part. The sampling continued until the crop was fully grown, then the rotorod air sampler shifted its position on the crop canopy, again when the crop was harvested, the position of the rotorod air sampler shifted to the ground level. The apparatus was protected from rain by a polythene sheet. Air sampling was carried out for two cropping seasons (November 2010 – March 2011 and to November 2011-March 2012).

Potatoes were planted on 10th November and harvested on 20th March in each crop seasons. Transparent cellotape was applied to the rods of the sampler, trimmed back to the width of the rods with sharp razor blade and then coated with vaseline. Then the air was sampled for 1 h in the morning. Air sampling was started 10 days prior to plantation of potato and continued for 10 days after harvesting of the same crop. After operating, the cellotape was removed, mounted beneath a cover glass using glycerine jelly and thus prepared the slides. Scanning of the prepared slides was done regularly throughout the investigating period. The trapped fungal spores were identified based on morphological characters visual identification by comparison with reference slides, published literature (Ellis, 1971; Barnett and Hunter, 1972; Gregory, 1973). Meteorological data during the study period was obtained from meteorological section of ICAR Research Complex, Lamphelpat, Imphal. The percentage contribution of the spore was calculated by:

$$\text{Spore percentage (\%)} = \frac{\text{Individual Contributions}}{\text{Total number of contribution of the observation day}} \times 100$$

RESULTS AND DISCUSSION

Analysis of spore catches and scanning of slides revealed 30 spore types. Out of these 30 spore types 22 belongs to Deuteromycotina, 2 to

Ascomycotina, 2 each to Zygomycotina, Basidiomycotina and Mastigomycotina respectively.

Epidemiology of Late blight of potato

Phytophthora infestans (Mont.) de Bary, is the causal organism of Late blight disease of Potato (*Solanum tuberosum* Linn). The disease affects leaves, stems and tubers. Water soaked spots or lesions appeared on the leaves during cool, wet weather. The spots appeared first from the leaf tip or margin and then it spread towards the middle of leaf.

The spots appeared first light green and then it turns brown. The blight lesions spread rapidly under favourable weather conditions, attacking petioles and stems. (Rawat and Kumar, 2013)

Incidence in the air

The data of first incidence *Phytophthora* spores in the air over potato plantation field appeared on 15th December, 2010 for the first year. Whereas the results is on 17th December, 2011 for the second crop season (Table 1 and 2).

Disease incidence and effect of weather

The Symptom of Late blight of potato was recorded first on foliage of the test crop on 17th January, 2011 and 14th January, 2012 for first and second crop seasons respectively. For the first crop season, the highest contribution of *Phytophthora* spore was recorded on 27th January, 2011 with the value of 11.34 per cent. The corresponding meteorological parameters recorded on that day were temperature (max. 22.5°C, min. 6.6°C), relative humidity (80%), rainfall (nil) and windspeed 4.5 km/hr). The period of maximum incidence of spore and disease appeared during the period for 17th January to 27th January. The period coincided with vegetative and tuberization phases of the crop (Table 3).

For the second crop season the highest contribution of *Phytophthora* spore was recorded on 3rd February, 2012 with the value of 8.23 per cent. The corresponding meteorological parameters recorded on that day 25.2°C (max). min. 2.6°C, R.H. 78 wind speed 2.7 km/hr and rainfall nil. (Table 3).

During the investigation period there is no spore of *Phytophthora* was found in the month of November and March. It may be due to unfavourable condition of the weather parameters to the patho-

Table 1 : Daily wise (%) contribution of spores of *Phytophthora infestans* Trapped by Rotorod air sampler from the potato plantation field of Imphal, first crop season Nov. 2010 to March 2011

Date	Concentration of Spores(%)	Temperature (°C)		Relative Humidity (%)	Wind Speed (km/hr)	Rainfall (mm)
		Max.	Min.			
15/12/10	3.95	17.3	5.4	83	1.2	-
16/12/10	3.16	21.1	5.8	83	1.7	-
17/12/10	4.74	22.4	6.5	93	1.3	-
18/12/10	5.27	21.6	4.9	83	1.3	-
19/12/10	4.74	23.0	8.1	83	1.3	-
20/12/10	5.01	22.4	5.9	83	1.9	-
21/12/10	5.27	20.6	4.5	84	1.7	-
22/12/10	6.59	21.4	3.7	76	2.04	-
23/12/10	7.91	20.6	4.6	82	1.8	-
24/12/10	7.12	20.4	3.4	76	1.5	-
25/12/10	8.17	19.8	3.1	80	1.8	-
26/12/10	7.38	19.9	3.0	80	1.9	-
27/12/10	8.17	20.4	3.0	80	1.7	-
28/12/10	7.91	19.8	3.2	75	2.0	-
29/12/10	8.97	20.2	2.8	77	1.1	-
30/12/10	2.37	20.7	3.1	80	1.1	-
31/12/10	3.16	20.8	4	83	2.8	-
1/1/11	1.23	21.4	4.5	78	3.3	-
2/1/11	0.98	22.4	6.7	81	2.9	-
3/1/11	1.67	22.7	7.9	77	2.0	-
4/1/11	1.52	21.9	4.5	76	1.8	-
5/1/11	1.87	21.2	4.6	80	2.2	-
6/1/11	1.67	21.8	7.5	89	1.6	-
7/1/11	1.97	21.8	5.5	80	1.2	-
8/1/11	2.26	24.2	5.6	81	2.9	-
9/1/11	2.56	2.40	10.0	95	2.4	5.9
10/1/11	1.77	22.4	11.6	88	4.0	-
11/1/11	2.66	21.9	5.8	84	2.4	-
12/1/11	2.81	20.7	3.8	79	2.5	-
13/1/11	3.00	21.2	6.2	85	2.4	-
14/1/11	2.95	21.2	5.9	85	2.5	-
15/1/11	4.43	21.3	3.4	77	2.6	-
16/1/11	0.93	20.8	4.0	90	3.0	-
17/1/11	2.95	15.2	7.5	83	4.4	-
18/1/11	4.43	17.5	6	81	7.4	-
19/1/11	4.63	18	6.0	84	5.4	-
20/1/11	2.95	16.6	5.5	75	2.6	-
21/1/11	4.93	18.6	2.0	78	1.9	-
22/1/11	4.43	17.2	2.4	79	1.6	-
23/1/11	4.98	16.9	2.9	74	3.0	-
24/1/11	5.91	19.5	3.6	81	4.5	-
25/1/11	5.81	20.4	4.0	86	3.5	-
26/1/11	5.91	21.4	3.5	72	2.3	-
27/1/11	11.34	22.5	6.6	80	4.5	-
28/1/11	4.63	22.5	7	79	2.7	-
29/1/11	2.95	22.4	4.6	72	2.1	-
30/1/11	4.93	22.7	4.2	78	2.4	-
31/1/11	4.63	23.0	3.6	79	4.6	-
1/2/11	8.77	22.6	8.5	82	2.6	-
2/2/11	9.94	22.3	8.6	7	1.8	-
3/2/11	8.18	22.5	5.2	80	1.8	-
4/2/11	7.89	23.4	4.5	7	1.8	-
5/2/11	7.30	24.4	5.0	81	1.7	-
6/2/11	5.55	24.2	6.0	82	3.7	-
7/2/11	7.89	24.8	6.0	76	3.8	-
8/2/11	7.30	24.2	7.6	81	3.0	-
9/2/11	5.84	24.6	8.4	88	5.8	-
10/2/11	5.55	24.4	8.3	84	2.2	-
11/2/11	5.84	23.4	3.5	88	2.2	-
12/2/11	7.89	24.1	3.9	83	3.6	-
13/2/11	5.84	23.4	4.4	80	3.1	-
14/2/11	1.46	23.8	5.6	78	3.2	-
15/2/11	2.63	23.6	9.8	80	4.0	-
16/2/11	2.04	24.2	8.9	80	5.0	-

Table 2: Daily wise (%) contribution of spores of *Phytophthora infestans* Trapped by Rotorod air sampler from the potato plantation field of imphal, Second crop season Nov. 2011 to March 2012.

Date	Concentration of Spores(%)	Temperature (°C)		Relative Humidity (%)	Wind Speed (km/hr)	Rainfall (mm)
		Max.	Min.			
17/12/11	4.18	22.0	3.4	87	1.9	-
18/12/11	3.35	22.8	2.5	73	2.0	-
19/12/11	5.02	22.9	2.1	94	2.0	-
20/12/11	5.58	23.8	2.0	66	1.5	-
21/12/11	5.02	23.7	2.0	91	1.8	-
22/12/11	5.30	24.2	1.9	97	1.8	-
23/12/11	5.58	24.3	2.5	81	1.9	-
24/12/11	6.98	20.8	3.5	91	2.1	-
25/12/11	8.37	22.6	7.1	95	1.7	-
26/12/11	7.54	25.6	7.2	85	2.4	-
27/12/11	8.65	25.8	8.9	89	2.5	-
28/12/11	7.82	25.5	9.8	81	2.4	-
29/12/11	8.65	25.9	7.5	91	2.1	-
30/12/11	8.37	25.6	5.4	88	2.0	-
31/12/11	9.49	245.9	4.5	87	1.9	-
1/1/12	1.15	25.9	6.0	87	2.2	-
2/1/12	1.44	16.9	8.5	88	1.6	9.7
3/1/12	1.55	19.6	8.8	96	2.3	2.5
4/1/12	1.73	20.8	9.6	95	4.1	3.0
5/1/12	1.78	22.3	8.2	77	8.1	7.8
6/1/12	1.32	22.0	5.2	84	3.9	6.6
7/1/12	1.61	23.7	6.5	71	3.3	6.2
8/1/12	1.96	23.8	7.7	90	2.3	2.9
9/1/12	2.19	17.9	11.5	92	2.6	0.1
10/1/12	2.07	2.07	6.5	95	2.8	4.0
11/1/12	2.30	24.0	11.5	88	2.7	2.1
12/1/12	2.59	23.8	9.0	91	2.5	-
13/1/12	2.65	22.5	7.9	88	5.4	-
14/1/12	3.00	20.4	2.6	85	3.7	-
15/1/12	2.30	21.9	2.4	89	2.3	-
16/1/12	2.65	22.0	4.6	84	3.7	-
17/1/12	3.11	21.4	3.5	89	5.9	-
18/1/12	3.00	17.2	5.9	83	3.6	0.2
19/1/12	3.11	22.2	5.2	85	1.8	-
20/1/12	3.29	18.7	5.5	92	3.9	-
21/1/12	3.57	20.2	8.9	98	9.1	8.1
22/1/12	3.52	22.6	4.1	87	3.7	-
23/1/12	3.46	22.7	2.1	80	4.9	-
24/1/12	5.19	22.4	1.7	74	3.5	-
25/1/12	5.42	22.7	1.1	76	5.0	-
26/1/12	5.77	22.9	1.1	71	4.9	-
27/1/12	5.19	22.7	1.1	73	4.7	-
28/1/12	5.42	22.2	1.0	76	1.9	-
29/1/12	5.77	23.5	1.0	84	3.0	-
30/1/12	5.83	24.6	2.0	84	2.9	-
31/1/12	5.88	24.9	1.8	71	2.4	-
1/2/12	7.78	25.0	1.9	72	5.1	-
2/2/12	7.09	24.3	2.6	74	2.5	-
3/2/12	8.23	25.2	2.6	78	2.7	-
4/2/12	6.17	25.8	3.0	71	3.0	-
5/2/12	4.57	25.7	3.8	76	7.5	-
6/2/12	5.72	24.5	5.5	86	7.5	-
7/2/12	6.40	25.0	4.8	84	4.3	-
8/2/12	6.17	26.4	4.2	62	2.8	-
9/2/12	4.57	7.3	6.6	85	3.5	-
10/2/12	4.34	26.6	13.0	83	6.5	-
11/2/12	4.57	27.3	5.4	92	6.6	-
12/2/12	3.43	27.2	3.6	95	6.6	-
13/2/12	4.57	25.9	2.4	78	4.3	-
14/2/12	6.17	27.0	3.5	64	5.3	-
15/2/12	5.72	27.4	6.1	57	5.0	-
16/2/12	4.34	24.3	8.2	85	5.0	-
17/2/12	2.05	28.7	8.5	75	8.1	-
18/2/12	5.72	27.9	10.6	64	6.1	-
19/2/12	4.57	25.7	6.4	93	6.0	-
20/2/12	1.60	24.8	3.8	56	5.4	-
21/2/12	0.68	25.8	4.5	63	5.6	-

Table 3 : Analysis of epidemiology of Late blight disease of potato in Imphal (Nov. 2010 to March 2011 to Nov. 2011 to March 2012 crop season)

Name of Disease	Causal Organisms	Crop season	Date of first incidence of spore in air	Date of first inset of disease	Highest contribution	Weather Condition				Period of max. incidence of spore and disease	Growth stage of crop	
						Temp Max.°C	Temp Min.°C	R.H. %	Windspeed km/hr.			Rainfall (mm)
Late Blight of potato	<i>Phytophthora infestans</i>	Nov.2010 to March 2011	15th Dec. 2010	17th Jan. 2011	27th Jan. 2011	22.5°C	6.6°C	80	4.5	-	17th Jan to 27th January	Vegetative and tuberization
Late Blight of potato	<i>Phytophthora infestans</i>	Nov.2011 to March 2012	17th Dec. 2011	14th Jan. 2012	3rd Feb. 2012	22.2°C	2.6°C	78	2.7	-	14th Jan to 3rd Feb.	Vegetative and tuberization

genic spore. High Humidity and temperature ranging from 17°C to 22°C may, thus to considered and ideal environment for quick and profuse sporulation (Puskarnath, 1976). The optimum temperature for the formation of sporangia is 21°C (Pandey, 1982). The presence of dew or water is necessary for the germination of sporangia. Between 10°C to 25°C sporangia casually germinate directly, but zoospores requires lower temperature (optimum 13°C). During disease development, rate of spore dispersal was influenced mainly by wind velocity which probably affects not the dispersal itself, but liberation of spores from formation sites (Rotem, 1963). The rates of inoculums (*Phytophthora infestans*) production and dispersal as well as viability and infactivity are the key factors that govern the rates of epidemic development (Bashi *et al.*, 1981). During the investigation period the correlation between weather parameter and concentration of spores were positively correlated with temperature, Humidity and windspeed whereas it is negatively correlated with rainfall.. Optimum humidity (R.H. above 90%) coupled with suitable temperature for germination of sporangia and further development of the disease are the principal predisposing factors.

The farmers need potato plantation from the months of September because it can prevent the attack of pathogens and escape the favourable condition of the pathogen to grow.

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