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FORECASTING LATE BLIGHT OF POTATO IN PUNJAB USING JHULSACAST MODEL

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ABSTRACT: Late blight of potato caused by *Phytophthora infestans* can cause huge loss to potato crop. Forecasting appearance of the disease in advance can help potato growers take timely action to prevent the disease and reduce the losses. Weather data collected in Punjab for 15 years (1997- 2012) was analyzed to calibrate 'JHULSACAST' - a model developed to forecast late blight in western Uttar Pradesh - to make it suitable to forecast appearance of late blight in Punjab. The model specifies that 7 day moving sum of RH ≥ 85% for at least 90 hr coupled with a 7 day moving sum of temperature between 7.2 to 26.6°C for at least 115 hr would predict appearance of late blight within 10 days of satisfying the conditions. The modified model was found suitable to predict appearance of late blight under Punjab conditions.

KEYWORDS: Forecasting late blight, *Phytophthora infestans*, Punjab, JHULSACAST

INTRODUCTION

Punjab has emerged as a major seed producing area of the country and caters to the huge demand of quality seed in India. Late blight caused by *Phytophthora infestans* is a devastating disease of potato which during certain years assumes epiphytotic proportions causing huge loss to the seed and ware potato crop. Worldwide potato crop losses due to late blight have been estimated at € 12 billion (Haverkort *et al*., 2009). Forecasting appearance of the disease in advance can greatly help potato farmers to take prophylactic sprays and prevent or delay appearance of the disease and thus reduce the losses. Weather conditions such as temperature, relative humidity, rainfall, dew, sunshine hours etc. have a direct effect on *P. infestans* (De Weille, 1963). These parameters have been exploited to develop different models to forecast the disease both in India and elsewhere (Cook, 1949; Wallin, 1962; Krause *et al*., 1975; Bhattacharyya *et al*. 1982; Singh *et al*. 2000).

The north-western subtropical plains of India is a unique agro-climatic zone where potato is grown in winter (October –January). Temperature between 10 to 25°C, RH >80%, cloudy/foggy days and occasional rainfall in certain years during November to January create conditions favourable for appearance of late blight. Nearly similar condition occur in subtropical plains of western Uttar Pradesh for which a late blight forecasting model namely 'JHULSACAST' has been developed by Singh *et al*, (2000). Keeping the 'JHULSACAST' model as a base the model was revised with different combination of weather parameters recorded in Punjab to develop a model suitable to forecast appearance of late blight under Punjab conditions.

MATERIALS AND METHODS

Late blight trap nurseries were raised with highly susceptible potato variety Kufri Chandramukhi at Central Potato Research Station, Jalandhar each year from 1997-98 to 2011 -12. Untreated seed tubers were planted

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in 1000 m^2 area at 60 × 20 cm spacing on September 25, October 10 and 25 each year. The crop was not sprayed with any fungicides to allow appearance of the disease. All other recommended practices were followed to raise the crop. Plants were critically examined for appearance of late blight starting from complete emergence till maturity of the crop. Appearance of late blight was also monitored in potato fields in different localities around the experimental farm.

Temperature and relative humidity data were recorded using daily thermohygrograph charts mounted on thermohygrograph machines housed in Steevenson screen placed within crop canopy. Other weather parameters viz. rainfall, sunshine hours, wind velocity and speed were recorded in adjacent observatory. Temperature and RH data was computed on hourly basis where as rainfall and sunshine hours were computed on daily basis. The data was converted into digital form and interpolated with the actual date of disease appearance using computer programme developed in Visual Basic. Model JHULSACAST was used as a standard and different combination of temperature and relative humidity recorded in the trap nurseries were evaluated for their fitness to predict late blight using computer programme developed for this purpose. Efforts were made to develop two models for late blight appearance for non rainy and rainy years. A Visual Basic software was also developed for data entry, modifications of weather data in Access RDBMS and analyzing data for forewarning of late blight appearance.

RESULTS AND DISCUSSION

Weather conditions such as 5 and 7 day moving sum of RH ≥85% for different number of hours in a blight congenial temperature of 7.2 to 26.6°C were found suitable for development of a late blight forecasting model. JHULSACAST model developed for western UP was used as such for predicting late blight appearance in Punjab for the period 1997-98 to 2011-12. The results of this JHULSACAST model revealed that the forecasting of late blight appearance worked in 5 years out of 15 years viz. 1999-2000, 2002-03, 2005-06, 2006-07 and 2007-08 when the disease appeared 2 to 10 days in advance of the predicted date. But disease appearance got delayed from 17 to 50 days from the stipulated date during the remaining10 years *i.e.*1997-98, 1998-99, 2000-01, 2001-02, 2003-04, 2004-05, 2008-09, 2009-10, 2010-11 and 2011-12 (**Table 1**). Therefore, it was felt that some modifications were required in this JHULSACAT model for predicting disease under Punjab conditions. Through analysis of weather parameters prevailing in Punjab in relation to actual appearance of the disease the condition of RH ≥ 85% for at least 50 hr found suitable under western UP was enhanced to 90 hr and the temperature between 7.2 to 26.6 °C for at least 105 hrs suitable under western UP was enhanced to 115 hrs. These parameters could predict appearance of late blight in Punjab during most of the years.

The results of modified model for Punjab revealed that the disease appeared within 1 to 10 days of completion of the weather conditions specified in the revised model during 11 out of 15 years and within 11 and 12 days of the predicted date during 2 years (**Table 2**). However, exceptions were observed also when the disease appeared within18 days during 2011- 12 and not appeared at all during 2000-01. The revised JHULSACAST model could predict the disease in 13 out of 15 years with an accuracy of around 87%.

Another model for rainy years was also developed. According to which measurable rain (0.1–0.5 mm) for minimum two consecutive days; 5-day moving sum of RH ≥ 85% favorable period 65 hours or more for 5 days and 5-day

Table 1. Prediction of late blight in Punjab through JHULSACAST model developed for western Uttar Pradesh.

Year	Date of Disease Appearance	Date of LB Prediction	Forecast in advance
2011-12	15 December, 2011	28 October, 2011	49 days
2010-11	03 December, 2010	13 November, 2010	20 days
2009-10	06 December, 2009	13 November, 2009	23 days
2008-09	20 December, 2008	01 November, 2008	50 days
2007-08	21 November, 2007	16 November, 2007	05 days
2006-07	12 November, 2006	06 November, 2006	06 days
2005-06	08 November, 2005	06 November, 2005	02 days
2004-05	19 December, 2004	07 November, 2004	42 days
2003-04	06 December, 2003	19 November, 2003	17 days
2002-03	28 November, 2002	18 November, 2002	10 days
2001-02	03 December, 2001	07 November, 2001	26 days
2000- 01	Not Appeared	01 November, 2000	-
1999- 2000	01 January, 2000	25 December, 1999	07 days
1998- 99	09 December, 1998	13 November, 1998	32 days
1997-98	30 December, 1997	04 December, 1997	26 days

Table 2. Prediction of late blight in Punjab through modified JHULSACAST model.

Year	Date of Disease Appearance	Date of LB Prediction	Forecast in advance
2011-12	15 December, 2011	28 November, 2011	18 days
2010-11	03 December, 2010	24 November, 2010	09 days
2009-10	06 December, 2009	29 November, 2009	07 days
2008-09	20 December, 2008	08 December, 2008	12 days
2007-08	21 November, 2007	19 November, 2007	02 days
2006-07	12 November, 2006	09 November, 2006	03 days
2005-06	08 November, 2005	06 November, 2005	02 days
2004-05	19 December, 2004	08 December, 2004	11 days
2003-04	06 December, 2003	05 December, 2003	1 days
2002-03	28 November, 2002	25 November, 2002	03 days
2001-02	03 December, 2001	30 November, 2001	03 days
2000- 01	Not Appeared	-	-
1999- 2000	01 January, 2000	28 December, 1999	04 days
1998- 99	09 December, 1998	07 December, 1998	02 days
1997-98	30 December, 1997	27 December, 1997	03 days

moving sum of congenial temperature (7.2 – 26.6°C) for 80 hours or more was arrived at to predict late blight 10 days in advance of its actual appearance. But this model could not be tested because the specified condition of rainfall was not fulfilled during all the 15 years of the study.

The current model specifies that a 7 day moving sum of RH $\geq$ 85% for at least 90 hr coupled with 7 day moving sum of

temperature between 7.2 to 26.6°C when occur for at least 115 hr late blight would appear within next 10 days. This model developed to forecast appearance of late blight in Punjab is a modification of JHULSACAST model developed by Singh *et al*. (2000) for western Uttar Pradesh. It was found suitable to forecast appearance of late blight in the main potato crop grown in Punjab from September/ October to January/February.

Forecasting late blight in advance can be a very useful tool for potato farmers which can enable them to take up prophylactic sprays of fungicides in time to protect their crop from late blight. Timely application of fungicides fungicides not only avoids/delays appearance of the disease but also checks the initial disease inoculum and thus slows down subsequent build up of the disease in the region. An accurate forecast of the disease appearance can help the farmers to avoid unnecessary use of fungicides, many rounds of which are generally applied even before the weather conditions become favorable for appearance of the late blight. Unnecessary use of fungicides can result in substantial increase in cost of cultivation besides causing environmental pollution. Use of the revised JHULSACAST model for Punjab can help the farmers to forecast appearance of the disease accurately and thus help to make judicious use of the fungicides.

CONCLUSIONS

JHULSACAST a model developed to forecast late blight in western UP has been revised to forecast the disease under Punjab conditions. The revised model specifies that a 7 day moving sum of RH $\geq$ 85% for at least 90 hr coupled with a 7 day moving sum of temperature between 7.2 to 26.6°C for at least 115 hr could forecast appearance of late blight within 10 days of meeting such conditions in Punjab.

LITERATURE CITED

Bhattacharyya SK, Raj S, Singh DS, Khanna RN and Ram S (1982) Forecasting of late blight of potato in Indian hills. In: *Potato in developing countries* (Eds. Nagaich BB, Shekhawat GS, Gaur PC and Verma SC). Indian Potato Association, CPRI Shimla: 414-24

Cook HT (1949) Forecasting late blight of potatoes and tomatoes. *J Agr Res* **78**: 545-63

De Weille GA (1963) Laboratory results regarding potato late blight and their significance in the epidemiology of blight. *Eur Potato J* **6**: 121-30

Haverkort AJ, Struik PC, Visser RGF and Jacobsen E (2009) Applied biotechnology to combat late blight in potato caused by *Phytophthora infestans*. *Potato Res* **52**: 249-64

Krause RA, Massie IB and Hyre RA (1975) BLIGHTCAST: A computerized forecast of potato late blight. *Plant Disease Reporter* **59**: 95-98

Singh BP, Ahmad I, Sharma VC and Shekhawat GS (2000) JHULSACAST: A computerized forecast of potato late blight in western Uttar Pradesh. *J Indian Potato Assoc* **27**: 25–34

Wallin JR (1962) Summary of recent progress in predicting late blight epidemics in United States and Canada. *Am Potato J* **39**: 306-12

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