ABSTRACT

Potato is a one of the important cash crops in India. The production of potato is constrained by the number of biotic and abiotic factors. Several pests and diseases cause substantial economic loss to potato growers. Late blight is one of the most devastating fungal disease of potato. Late blight is caused by the oomycete pathogen *Phytophthora infestans*. It occurs in severe form once in 3 to 4 years in the Indo-Gangetic plains. Late blight is believed to be a 'weather-driven' disease, dependent on two major climatic factors viz. moisture and temperature. In addition to weather, farm management practices such as irrigation, cultivar and farming system also contribute to the potential risk of the disease. Under congenial weather conditions, and without intervention (i.e. fungicide sprays), late blight appears in epiphytotic form and this leads to complete damage of the aerial part of the crop within a few days. In recent years, it has been exacerbated by the introduction of new strains of *P. infestans* that are genetically more variable, aggressive and resistant to fungicides than the 'old' strains. Presently, potato growers of West Bengal face huge economic loss due to frequent occurrence of late blight disease. The non-judicious preventive spraying has increased cost of production as well as environmental hazard. Disease control could be more efficient if disease patches within fields can be identified early and treated locally using variable rate application of fungicide. Potato growers operating in large-scale require timely and location-specific information on disease occurrence for effective control of disease while reducing pollution risks from pesticides. So, the present research program has been designed to develop an effective potato late blight disease monitoring system that may help the farmers to shift from traditional calendar-based spray to judicious need-based spray program.

The present study has been designed with three different components: a) Delineation of potato growing areas and phonological profile of crops using MODIS NDVI data, b) comparison of spectral character of healthy and diseased crop using Handheld Spectroradiometer and c) assessment of PLB affected areas and disease severity using multispectral vegetation indices derived from AWiFS from Resourcesat-2 data.

To know the potato crop life cycle crop Phenological matrices were analysed by using time series MODIS NDVI data and spatio-temporal pattern of potato crop was extracted from other crops. The NDVI-based improved pixel dichotomy model was used for retrieval of

potato canopy fraction which is favourable for micro-environment of potato late blight disease infestation.

The reflectance spectra of the healthy and late blight disease affected potato crop canopy at different disease severity levels were recorded by using a handheld Spectroradiometer. The purpose was to select the appropriate regions of the electromagnetic spectrum for PLB disease initiation and temporal severity. The critical spectral regions in which the difference was prominent between healthy and diseased canopy include, 700 and 740 nm (70.17%), 770-860 nm (77.00%) and 920–1040 nm (65.71%). Correlation study was carried out among different spectral variables, sensitive to PLB disease, and field measured PLB disease severity. Out of all the spectral variables, $NDVI_{705}$ and DWSI-5 showed significant negative correlation (0.87 and 0.84) to predict the different level of PLB disease severity. A scientific disease severity scoring methodology for remote monitoring of potato late blight disease was developed from the above mentioned spectral variables using multi-linear regression model which makes it suitable for real-time potato late blight disease monitoring system.

To distinguish the disease affected potato crops from the healthy ones different AWiFS derived vegetation indices viz. NDVI, NDWI, ABDI, and PPCF and late blight risk zone map in the potato growing areas were delineated for the years, 2012-13 and 2013-14. The satellite derived disease affected areas showed good matching with the ground based measured area given by State Agriculture Departments with RMSE ranging from 6.38 to 10.47 and coefficient of determination (R^2) between of 0.85 to 0.88. Correlation of different vegetation indices with field measured PLB disease severity index (DSI) showed significant linear relationship of NDVI and PCCF with PLB score values. A multi-linear regression model was developed to predict the late blight disease severity in spatial scale using NDVI and PCCF as independent variables. By using this scientific disease severity scoring methodology disease epidemics and their progress rate was successfully identified and monitored in spatio-temporal basis. The results of the present study can help in developing a Remote Sensing based PLB Monitoring System that can be used for operational crop management.

Keywords: Late blight, Monitoring, Spectroradiometer, Potato, Disease Severity, AWiFS, Vegetation Indices.