Society for Advancement of Wheat and Barley Research
ICAR-Indian Institute of Wheat & Barley Research
Karnal - 132 001, India

Journal of Wheat Research
8(2):54-56
Homepage: http://epubs.icar.org.in/ejournal/index.php/JWR

Short Communication

Wheat stripe rust detection of probable alarm zones in *Rabi* 2012-13 and 2013-14 seasons

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Article history: Received: 16-11-2016, Revised : 26-11-2016, Accepted: 28-11-2016

Citation: Dutta S, MS Saharan and I Sharma. 2016. Wheat stripe rust detection of probable alarm zones in Rabi 2012-13 and 2013-14 seasons. *Journal of Wheat Research* **8**(2):54-56.

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In India, earliest reviews pointed that awareness of the role of weather on pests and diseases existed in the early forties. Mehta (1940) pioneered the work on the role of environmental factors in the epidemiology of wheat rust. Wheat rusts are weather sensitive and determining weather conditions conducive for their growth and their proliferation can help in locating the likely regions and periods of occurrence. Short and medium-range weather forecasts make models as useful planning tools for initiation of control measures on the basis of weather warnings. Monitoring one or more important weather parameters for initiation of a pest and disease would merit the issue of a warning in the form of likely pest alarm zones.

Aim of this study was to identify stripe rust (yellow rust) affected areas of wheat crop using combination of weather data and satellite remote sensing data. Moderately low temperature and high humidity are the favourable conditions for the growth of yellow rust pathogen(*Puccinia striiformis f. sp. tritici*). Most affected areas of Haryana and Punjab were Yamunanagar and Roop Nagar, respectively. Data were used from Meteorological and Oceanographic Satellite Data Archival System (MOSDAC) site as well as ground truth observation points collected by IIWBR, Karnal. To set the correlation between the minimum temperature, maximum relative humidity and minimum surface heat flux, ERDAS Imagine 9.1, and Envi 4.1. Softwareswere used as well as the NDVI (Normalized difference vegetation index), LSWI (Land surface water index) values of multi-date satellite data. Multi-date stacked layers of FCC (False Colour Composition) was used to classify images for obtaining wheat area. Weather data received from MOSDAC site is of 5km resolution so it takes the mean values of classified images and check the spectral profile of NDVI, LSWI images and its assumed that spectral profile of NDVI shows dip in one of the date i.e. below 120 and if there is no cloud or haze on a particular date then it might be yellow rust affected area. This is also validated by the GPS positioning of the ground truth observations of disease affected locations. It is basically an attempt for identification of healthy and diseased crop as well as an attempt to develop a forecasting model for Identification of weather conditions which will become handheld tools for planners to expedite relief measures in case of more prone areas of yellow rust as well as for farmers to know the affected areas of yellow rust and

*Methodology followed: i)*Weather Research Forecasting (WRF) model derived daily weather data at 5 km resolution were used from Feb. 1- Feb. 28, 2013 and Jan. 1- Feb. 28, 2014 which showed the boundary conditions limiting the extent of prevailing favorable weather conditions for wheat stripe rust. ii)WRF model derived weather data were used as input parameters for determing the boundary conditions prevailing for disease incidence are Maximum and Minimum ambient temperatures, maximum relative humidity and minimum upward surface heat flux which was taken from -10 to -70 watt/m^2 which shows the region of abundant dew, iii) Multi-date IRS AWiFS satellite data was used at 56 m resolution of Feb.1, Feb.11, Feb. 20 and Feb. 25, Mar. 2, Mar.7, Mar. 17 2013

and Jan.-March, 2014 iv)The intersection region in Punjab and Haryana states of 15-25 °C maximum temperature, 5-15 °C minimum temperature, upward surface heat flux of -10 to -70 W/m^2 and greater than 80 % maximum relative humidity prevailed over 1-to -28 February, 2013 and 1-to -28 February, 2014 were taken as probable region of affliction, v) Multi-date Indices NDVI, LSWI derived from IRS AWIFS data were used to arrive at the group of block level affected areas, vi) Even after taking the corrective measures by the farmers, the dominant areas of the disease affected areas where probable yield reduction will be reported was extracted from images, vii)The flow diagram for wheat rust forewarning using WRF derived meteorological data are shown in fig.1 depicting the probable region of infestation which can be forecasted 3 days in advance using 3 day weather forecast of the WRF model, viii)The flow diagram for detecting the wheat rust affected areas using multi-date AWiFS data and deriving indices for segregating the diseased areas compared to healthy wheat growing areas in shown in Fig.1.

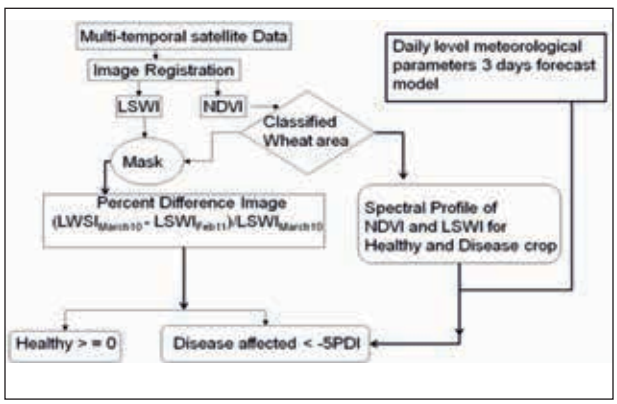

Fig. 1 The flow diagram for detecting the wheat rust affected areas using multi-date AWiFS data

The zone of infestation could be found through analyses of daily level WRF model forecast of meteorological data from Feb.1-28, 2013 shown in Fig. 2. The alarm zone could be predicted in the northern region of Haryana, southern Punjab and southern H.P. The analysis of multi-date sequence of AWiFS data of Feb. 11, Feb. 20, Feb.25, Mar. 2, Mar.7 and Mar. 17, the following areas in Haryana and Punjab have been found to be probable wheat rust affected areas. The dominant areas of the disease affected areas where yield will be reduced could be depicted by monitoring sequence of AWiFS data and pattern of NDVI profile deviating from that of the healthy crops.

The areas In Sarawan block of Yamunangar district were affected. Similarly villages in Ambala bordering Yamunanagar were also affected (Fig.3).

Fig. 2 Region in green showing the intersection of max. temperature 10-25 °C and RH above 80% over Feb. 1 -15, 2013 period using WRF model in 2013

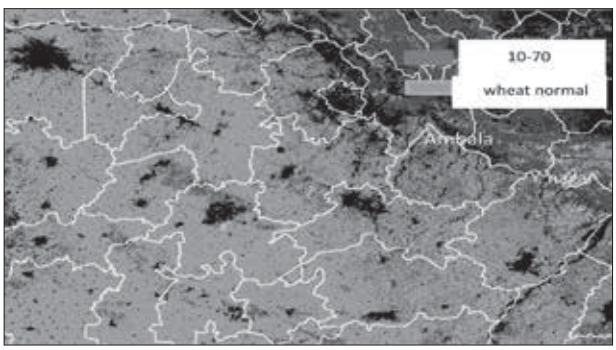

Fig. 3 Scatter pixels in red depicting the region of yellow rust incidence in Haryana districts, 2013

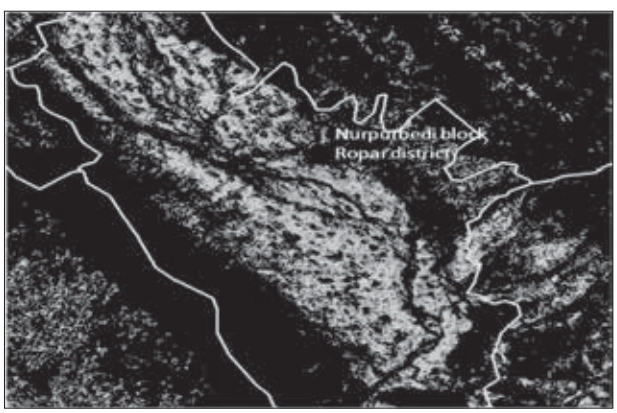

Fig. 4 Detailed picture of rust infected areas in Nurpur Bedi block of Ropar district. The region in red are diseased wheat areas and green are healthy wheat areas in 2013.

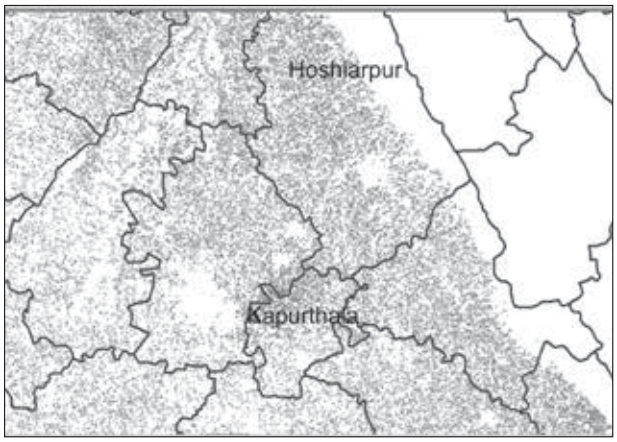

Fig 5. Scatter pixels in red depicting the region of infestation in Punjab districts, 2013.

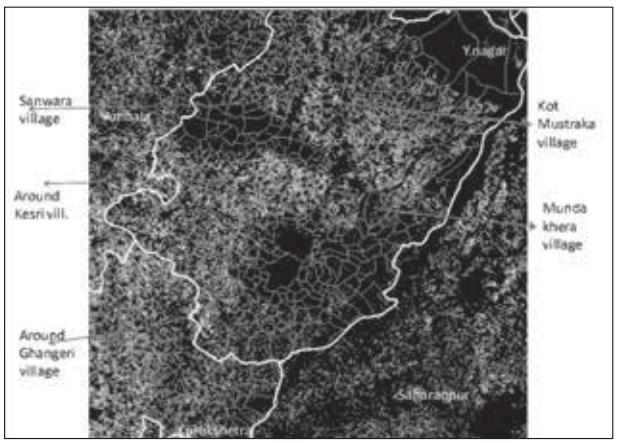

Fig. 6 Detailed picture of rust infected areas with village boundaries. The region in yellow and pink are diseased areas and green are healthy wheat areas.

During 2014-15 crop season, the zone of incidence could be found through analysis of daily level WRF model forecast of meteorological data from Feb.1-28, 2014. This year large area of incidence could not be found as it was controlled at initial stage of incidence using fungicide.

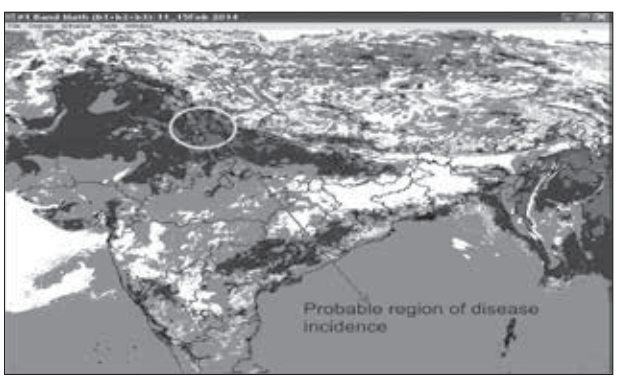

Fig 7. The probable area of incidence based on intersection of weather data

The zone of incidence could be found through analysis of daily level WRF model derived 3 day forecast of meteorological data from Feb.1-28, 2014. The alarm zone could be predicted in the northern region of Haryana, southern Punjab and southern H.P. The analysis of multi-date sequence of AWiFS data of Feb. 11 to Mar.17 large area of incidence could not be found. Demarcation of ago-climatic boundaries for defining the different levels of pest/disease incidence and its severity level is shown in Fig. 4-7.

Gridwise pest and disease multi-year data need to be collected through random sampling to develop empirical model and validate large scale model estimates.

Acknowledgement

Authors are grateful to Director SAC (ISRO), Ahmedabad for his support and encouragement to carry out this study and Ministry of Agriculture (MoA) for the funds provided under FASAL R&D project for this study. Authors are grateful to MOSDAC team for providing the WRF derived parameters.

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