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SATELLITE TELEVISION CLOUD PHOTOGRAPHY AS A POSSIBLE TOOL TO FORECAST PLANT DISEASE SPREAD

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STUDIES on the nature of spread of wheat stem rust (*Puccinia graminis* f.sp. *tritici* Eriks. and Henn) have established that it moves from the hill areas in South India northward[1]. This is contrary to previous findings[2,3], which showed that the disease spread was bi-directionally from Central Nepal to the North Indian plains and from hills in the South to Central India.

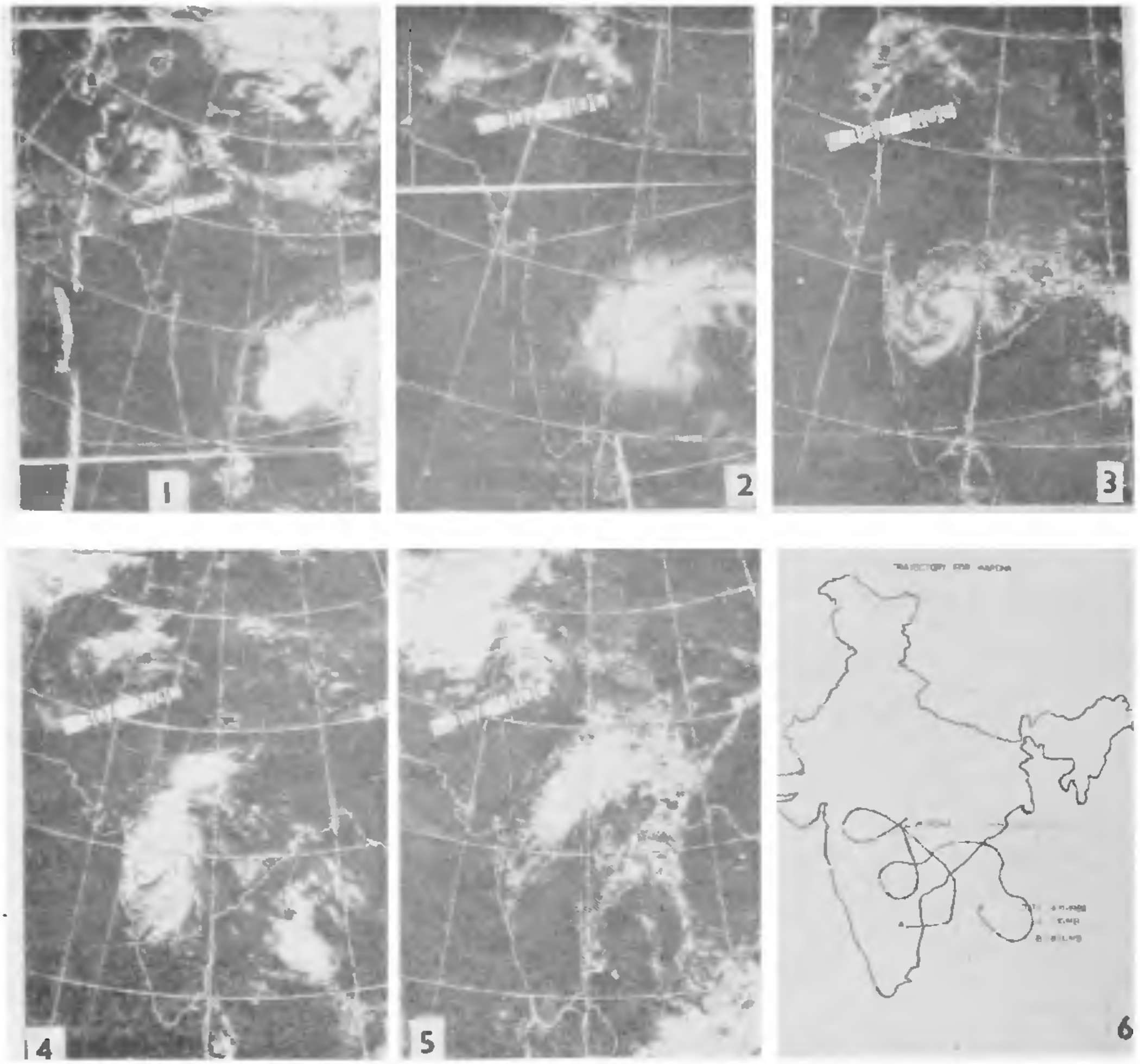
Uredospores serve as the primary inoculum for the establishment of the disease each season. These spores are carried over long distances by wind, and deposition occurs by rain[4,5].

During January 1970, the Wheat Disease Survey Team of the Indian Agricultural Research Institute observed some wheat fields with 60–80% severity of stem rust attack near Wardha, in Maharashtra State in Central India. Field epiphytotic studies also indicate that at least 55 to 60 days are needed to reach this severity when the primary inoculum level is at one pustule per 238 tillers (unpublished data). From the survey data it appears that the primary inoculum was at a relatively low level and several cycles of multiplication had occurred in the affected fields. The deposition of the primary inoculum under these circumstances probably occurred with the meteorological conditions that prevailed during the month of November, 1969. The present study reviews the meteorological conditions occurring during this period and attempts to correlate satellite television cloud photography (STCP) with the observed rust development and weather.

Satellite television cloud pictures have been studied both by the meteorologists and space scientists for purposes of forecasting weather conditions[6-8]. The STCP negatives from the weather satellite, ESSA-9, reel 5, track 9 and 10 for the period 1 to 15 November 1969 were received from the National Climatic Center, Asheville, N.C. 28801, U.S.A. During this period, ESSA-9 was in a circular sun-synchronous polar orbit at an average altitude of 910 statute miles above the earth's surface, with cameras of 1 inch diameter vidicons of the Advanced Vidicon Camera System type, and pictures are taken every 120 seconds.

Certain meteorological conditions have been found to be associated with the dissemination of the *P. graminis* f.sp. *tritici* in India (unpublished data). Occasionally, a depression/low pressure center forms in either the Bay of Bengal or the Arabian Sea (10–15° N; 70–90° E) in the months of November and sometimes crosses over to Central India. Such a condition would create a weather system that could explain the long distance transport of rust spores from South India to parts further north. The STCP brought out the presence of a well-organized bright spiral cloud system with circulation center being clearly visible on November 5, 1969 (Fig. 1). The extensive clouding associated with the system extended upto the east coast of India. The cyclonic storm crossed the coast on the following day as is evident from STCP of November, 6, 1969 (Fig. 2). Thereafter the depression moved in a west-northwesterly direction and weakened gradually. As a consequence, intense clouding persisted as bright bands over Wardha (79° E; 21° N) until November 9, 1969. This system caused heavy precipitation in many parts of Central India accompanied by a cyclonic air movement over Wardha.

As the depression was moving across coastal Andhra Pradesh, high speed southerly winds were traceable over the hill areas in South India. From the satellite photographs of November 7 and 8 of 1969 (Figs. 3 and 4) it was clear that at least a part of the moisture and cloud system that moved to the depression area located on coastal Andhra Pradesh was passing over the Nilgiris and Palani Hills (77° E, 11° N), which appear to be the main sources of stem rust inoculum. Such a wind pattern persisted for a period of approximately 48 hours. Using the synoptic weather charts, trajectories of the spore cloud movement for 700 and 850 mb heights (A and B in Fig. 6) were drawn following the method of Petterson[9]. Trajectory A drawn for 700 mb height started near the inoculum source on November 7, 1969 at 18·00 hrs GMT and ended over Wardha on November 9 at 06·00 hrs GMT. It made a loop over Wardha and ended on November 10, at 24·00 hrs GMT. Trajectory B started from the marked place in the Bay of Bengal on November 5, 1969 at 21·00 hrs GMT and ended over Wardha on November 9, at 06·00 hrs GMT (Fig. 6). The trajectory for the spore cloud at 700 mb height was calculated to require 36 hours, to move from the inoculum source area to the Wardha area. The time of take-off from the source coincides approximately, with the passing of the moisture and cloud system which can be seen in Fig. 2. It appears that the uredospores of wheat



FIGS. 1–5. are the Satellite Television Cloud Photographs of ESSA-9 for November 5-9, 1969 taken at 09·24, 08·06, 09·04, 08·08, and 09·07 hrs GMT respectively. Fig. 6 is the trajectory drawn for 700 mb height (A) and 850 mb heights (B) respectively.

stem rust were disseminated at 700 mb height, and that their path could be associated with the visible stratus type cloud movement.

The apparent relationship of the general epidemiological pattern of stem rust with the weather situation in the 1969–70 season and the STCP provides a field of research whereby the potential for forecast of long distant disseminated disease causing organisms appears to be promising. Detailed studies of similar records and for other years will be published elsewhere.

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