

Weather based operational plant protection of leaf spot disease of groundnut

N. CHATTOPADHYAY, R. P. SAMUI and S. N. WADEKAR

India Meteorological Department, Pune - 411 005, India

(Received 4 January 2001, Modified 22 May 2002)

सार – इस शोध-पत्र में मूँगफली के पत्तों पर लगने वाली चित्ती बीमारी की घटनाओं के लिए मौसम की अतिसंवेदनशीलता का अध्ययन किया गया है। देश के विभिन्न भागों में किए गए नियमित सर्वेक्षण के दौरान पी.पी.क्यू. और एस. द्वारा संग्रहित किए गए आंकड़ों से यह पता चलता है कि वर्ष 1988–1998 के दौरान खरीफ और रबी दोनों फसलों के मौसमों में आंध्र-प्रदेश, कर्नाटक, गुजरात और महाराष्ट्र में बीमारी अक्सर लगती हैं। वर्षा और मेघाच्छन्न की स्थितियों से संबद्ध तापमान में आने वाली कमी जैसी मौसम संबंधी प्रणालियों से सापेक्षिक आर्द्रता में होने वाली वृद्धि इस बीमारी के फैलने के लिए अनुकूल हैं विशेषकर फसल में मूँगफली बनने की अवस्था से लेकर मूँगफली के पकने की अवस्था। वर्षा से संबद्ध मेघमयता की स्थितियों (2–8 ओक्टा) में अधिकतम तापमान में 30° से. के बराबर या उससे अधिक की कमी तथा प्रातःकाल और अपराह्न की सापेक्षिक आर्द्रता में क्रमशः 80 प्रतिशत और 60 प्रतिशत के बराबर या उससे कम होने वाली वृद्धि, साधारण से अधिकतम तीव्रताओं में रोग के फैलने के लिए अनुकूल पाई गई है। कृषि मौसम विज्ञान सलाहकार सेवा के माध्यम से सही समय पर पादप संरक्षण उपायों का प्रयोग करने के लिए मूँगफली पर होने वाले चित्ती रोग की घटना की पूर्व सूचना हेतु इस रोग की घटना पर क्षेत्रीय प्रेक्षकों सहित मौसम आधारित सूचना का उपयोग किया जा सकता है।

ABSTRACT. Sensitivity of weather to the incidences of the leaf spot disease on groundnut was studied. Using data collected by PPQ & S during regular survey in different parts of the country it was observed that the disease occurred more frequently in Andhra Pradesh, Karnataka, Gujarat and Maharashtra both in *kharif* and *rabi* seasons from 1988-1998. Weather systems causing drop in temperature associated with rainfall and overcast condition leading to increase in relative humidity favoured incidence of the disease particularly when the crop was in pod formation to maturity stages. Decrease in maximum temperature $\leq 30^{\circ}$ C and increase in morning and afternoon relative humidity $\geq 80\%$ and 60% respectively under cloudy condition (2 - 8 okta) associated with rainfall were found to be congenial for the development of the disease in moderate to severe intensities. This weather based information along with field observations on incidence of this disease could be used to forewarn the incidence of the leaf spot disease on groundnut for taking plant protection measures at appropriate time through Agromet Advisory Service.

Key words – Leaf spot disease, Synoptic system, Meteorological parameters, Forewarning, Plant protection, Agromet Advisory Services.

1. Introduction

Among the oilseed crops, groundnut enjoys pre-eminent status in the oilseed profile of the country both in terms of area and production. There is a great deal of instability in the groundnut production in the country due to pests and disease attack. Leaf spot is a major disease of groundnut particularly grown in Gujarat, Andhra Pradesh, Karnataka and Maharashtra. Sundaraman (1965), Jackson and Bek (1969), McDonald and Flower (1977), Subramanyam and Ravindranath (1988) reported substantial yield losses of groundnut due to the incidence of the leaf spot disease on groundnut. Timely forecast on the

occurrence, spread and intensity of the disease enables the end users to take appropriate measures to prevent such loss. A number of workers (Sulaiman and Agashe 1965, Ramkrishnam and Appa Rao 1968, Chohan 1974, Venkataraman and Kazi 1979, Dubey *et al.*, 1995) in the country investigated the role of weather on the incidences of leaf spot. In the present study, attempt has been made to explore the possibility of forewarning the incidence of leaf spot operationally based on the prevailing synoptic situation causing the variation of weather parameters favourable for the disease incidence. The ultimate aim of this study is to include advisories on plant protection of leaf spot on groundnut grown in different agroclimatic regions of the

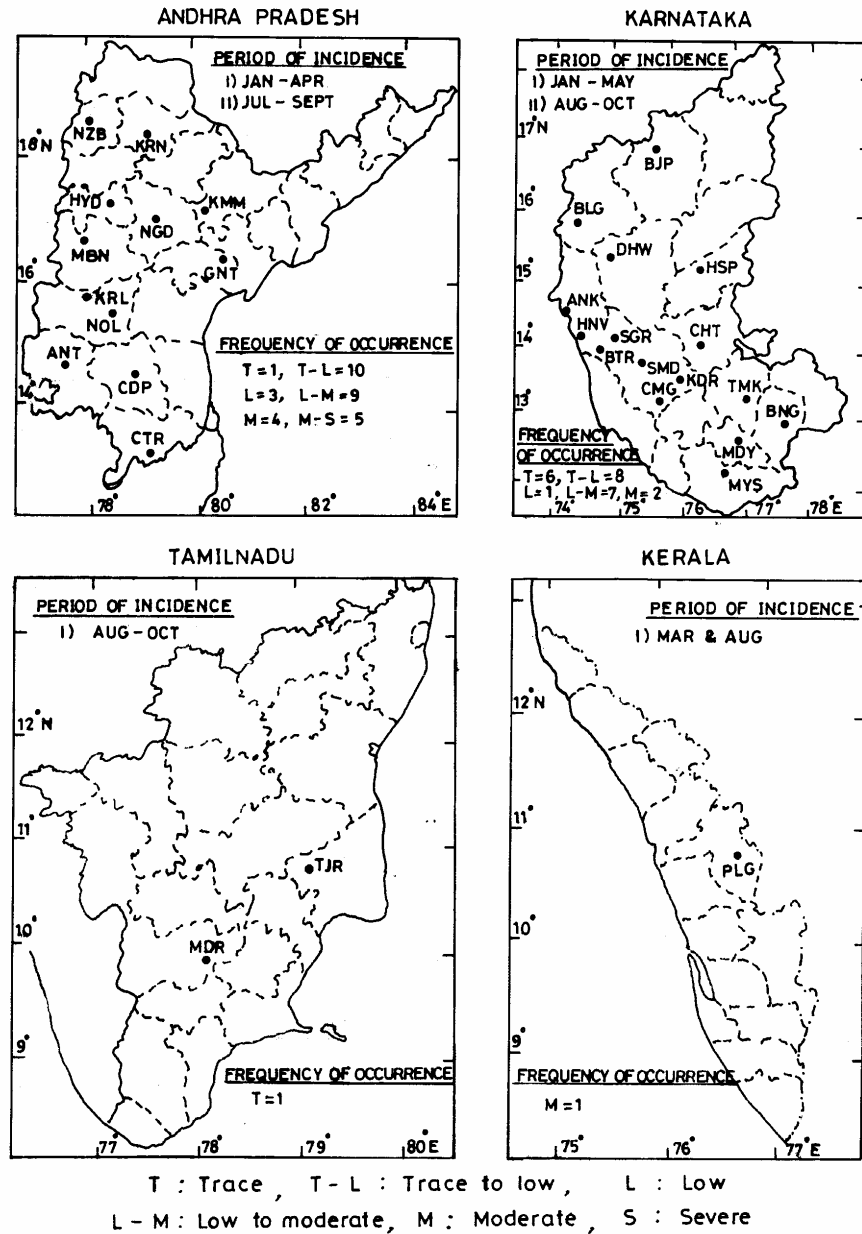


Fig. 1(a). Locator map of stations in south Indian states reporting Tikka disease incidence

country through Agromet Advisory Service bulletin issued from different National Meteorological Centres and Agricultural Universities.

2. Data and methodology

The disease data alongwith the date, place of attack and stage of the crop and damage caused by the disease in different parts of the country for a period of 11 years (1988-

1998) were collected from the monthly Rapid Roving Survey Report issued by the Central Integrated Pest Management Centre, Directorate of Plant Protection, Quarantine and Storage (PPQ&S), Faridabad. The disease data were recorded during the survey conducted by PPQ&S in different well-defined routes in the states. Based on the above information, the disease prone areas, time and frequencies of disease occurrence in different intensities were delineated. Meteorological parameters such as rainfall,

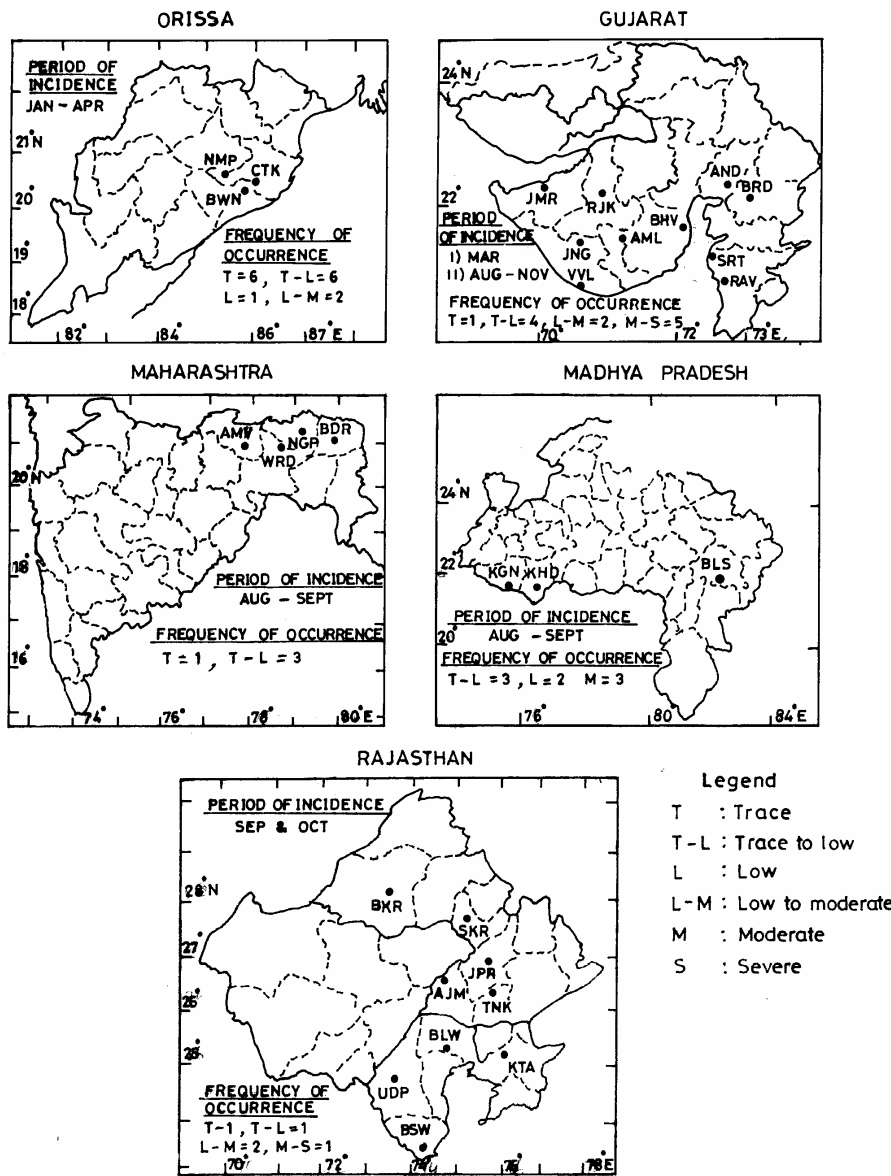
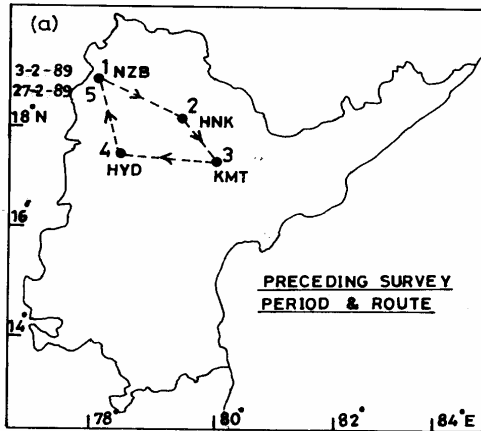


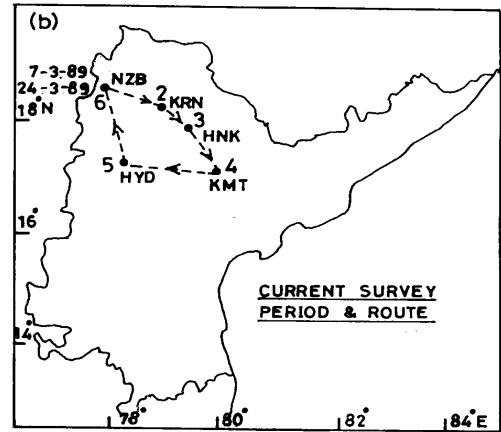
Fig. 1(b). Locator map of stations in central and northwest Indian states reporting Tikka disease incidence

maximum and minimum temperature, relative humidity (0300 and 1200 UTC), cloud amount (0300 and 1200 UTC) recorded at different stations during the period of disease incidence were obtained from the National Data Centre, IMD, Pune. Information on the synoptic situation from weekly weather reports and synoptic charts were obtained from the office of DDGM (Weather Forecasting), IMD, Pune. Nine stations from three states namely Andhra Pradesh, Gujarat and Maharashtra reported moderate to severe disease incidence. These stations were selected to

study the sensitivity of the meteorological parameters on the incidence of the disease. Variations of meteorological parameters between two consecutive survey periods *i.e.* during preceding and current survey period were analysed critically [Figs. 2(a&b)]. Prevailing synoptic situations during the above mentioned periods were also studied with relation to disease incidence. Graphical superimposition techniques were also applied to understand the relation between weather parameters and disease incidence. Critical values of the corresponding meteorological parameters



Crop condition : Flowering to pod formation
 Disease intensity : Low infection of Tikka leaf spot has been recorded in Karimnagar and Nalgonda



Crop condition : Maturity to harvesting
 Disease intensity : Moderate to severe intensity of Tikka leaf spot has been observed in fields of Karimnagar, Warangal and Nalgonda

Figs. 2 (a&b). Disease and crop information in two consecutive surveys in Andhra Pradesh

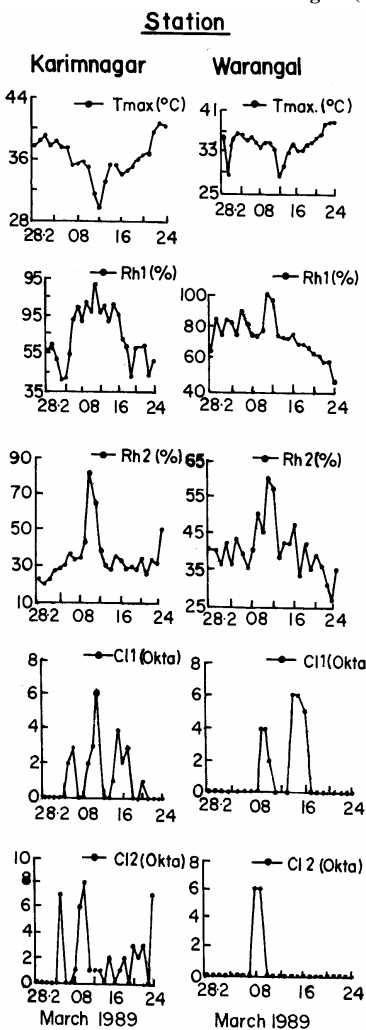
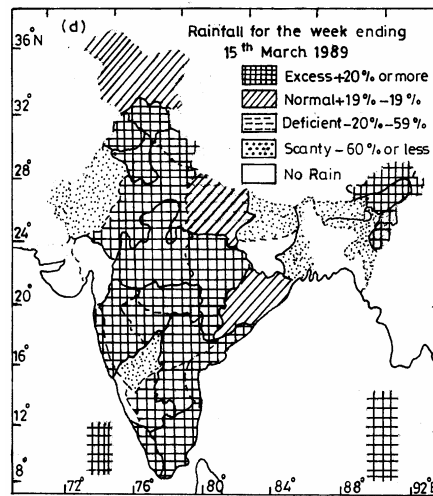
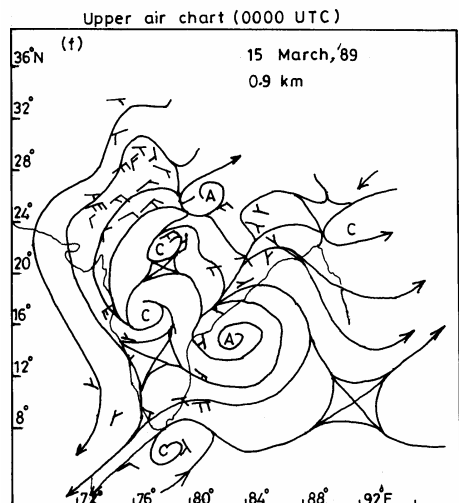
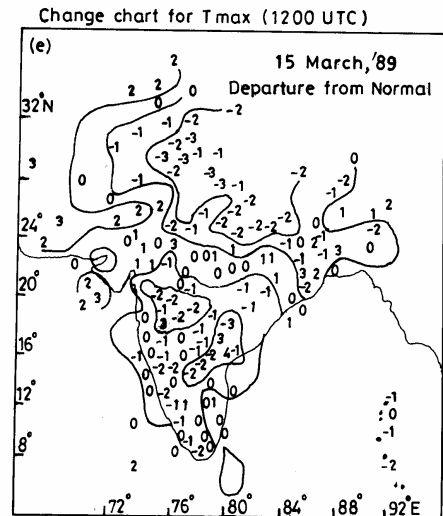


Fig. 2(c). Variation of meteorological parameters during the period of disease incidence



Rainfall was excess in A.P. The following stations received heavy rainfall on 11, Kurnool -7cm, Kalingapatnam -6cm, Hyderabad -5cm, Rain or thundershowers occurred almost all the places on 1 to 2 days in A.P.

Fig. 2(d). Rainfall during the period of disease incidence



Figs. 2(e&f). Synoptic situation during the period of disease incidence

favourable for the disease incidence were also worked out. Observed findings were also compared with the normal weekly average meteorological parameters.

3. Results and discussion

The incidence of leaf spot in different groundnut growing states in the country is shown in Figs. 1 (a&b). It is interesting to note that the disease affected the groundnut grown in Andhra Pradesh, Gujarat and Karnataka more frequently during south-west monsoon period. It appeared in number of stations in Telangana and Raylaseema sub-division of Andhra Pradesh, south east Rajasthan, both north and south interior Karnataka, southern part of Gujarat and Vidarbha region of Maharashtra. These regions were identified as the highly prone zone for the disease to occur. Under favourable weather conditions the disease appeared in epidemic form and cause substantial damage to the groundnut in the above sensitive regions leading to a chain of socio-economic problems.

In order to provide advance information of the occurrence of the disease on the crop grown in the prone areas of the country, extensive analysis was made to observe the disease incidences in relation to the prevailing synoptic situations and variations of the meteorological parameters before and during the survey periods when disease was reported to appear in moderate or moderate to severe conditions.

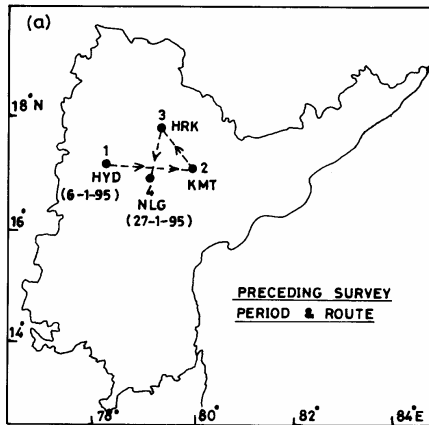
The leaf spot was reported to occur in moderate to severe condition in scattered fields of Karimnagar, Warangal and Nalgonda in Telangana sub-division of Andhra Pradesh during the survey carried out from 7 to 24 March, 1989 [Fig. 2(b)]. During this period the groundnut crop was at maturity to harvesting stages. Analysis of meteorological parameters during and before the survey periods at Karimnagar and Warangal showed that there was a marked decrease in maximum temperature from 6 to 12 March, 1989. At Karimnagar it decreased from 37.2° C to 29.0° C while at Warangal it dropped from 34.6° C to 28.0° C [Fig. 2(c)]. Normal weekly maximum temperature for both these stations during this period is 36.0° C. For the week ending 15 March 1989 there were three western disturbances in Pakistan and adjoining northern parts of the country along with induced cyclonic circulations in Punjab, Himachal Pradesh, Rajasthan and Haryana. Under the influence of the systems and favourable wind direction, maximum temperature decreased over the peninsular region Fig. 2(e). During this period relative humidity increased well above the normal (75% morning humidity and 31% afternoon relative humidity). Morning relative humidity increased even as high as 100% at Warangal on 10 March. Clouding (5-6 okta) persisted throughout the day on 10 and 11 March. High clouding over the station might be due to the presence

of the trough with embedded cyclonic circulation extending from Kerala to Maharashtra and circulation over MP (Fig. 2f). Rainfall was above normal in Andhra Pradesh in this week due to the above systems [Fig. 2(d)]. The above observations are in consonance with the findings of Jensen and Bogle (1965) Ramakrishna and Appa Rao (1968), Venkataraman and Kazi (1979), Smith (1986) and Dubey *et al.*, (1995). Dubey *et al.*, (1995) also observed fall in mean temperature during first fortnight of August at Akola where disease affected the crop to a great extent. Ramakrishna and Appa Rao (1968) reported that a period of 3 days of high humidity was essential for maximum infection of the disease.

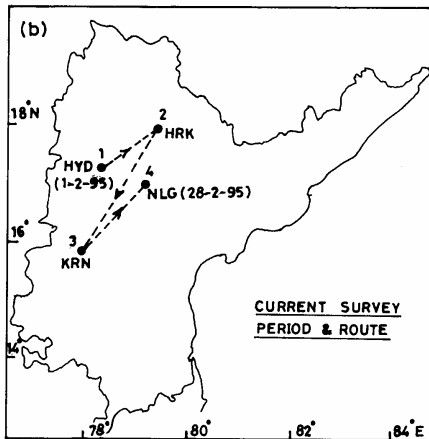
In 1995 moderate to severe infection of the disease was reported from Nalgonda, Warangal and Rangareddy districts of Andhra Pradesh during 1 to 28 February [Fig. 3(b)]. Groundnut was in pod formation stage during this period. At Hyderabad and Kurnool, there was a sudden drop of maximum temperature from 16 January to 18 January. At Hyderabad it decreased from 26.0° C to 20.5° C and in Kurnool it dropped from 30.0° C to 26.5° C. Weekly normal maximum temperature was found to be 30.0° C during this period. On 15 January, a western disturbance formed over J and K alongwith the induced cyclonic circulation over Rajasthan, Madhya Pradesh. Under its influence severe cold wave condition prevailed in northern part of the country. Major parts of Andhra Pradesh also experienced the low maximum temperature [Fig. 3(e)]. From January 14 to 17, both morning and afternoon humidity were increased above 80% and average clouding during these days was about 6 okta [Fig. 3(c)]. A number of synoptic features like trough in easterlies from south Tamil Nadu to north interior Karnataka and trough from Comorin to south Telangana caused substantial rainfall in different parts of the state [Fig. 3(d); Fig3. (f&g)].

Similar inferences about the inter-relation of the disease incidence with the maximum temperature, relative humidity, cloud, rain were obtained when the disease occurred in moderate and moderate to severe intensities at Nagpur and Wardha in Vidarbha region of Maharashtra from 22-28 August, 1989 and Anand and Nawsari of Gujarat region from October 1-10, 1988. In both the cases marked decrease in maximum temperature along with the increase in humidity and clouding under rainfall condition (Table 1) were reported.

Thus, it was found that decrease in maximum temperature alongwith the increase in relative humidity under cloudy and rainfall conditions favoured the incidence of leaf spot disease. A critical analysis of the results during the period of occurrence of the disease indicated that drop of maximum temperature of 3.0° C or less when the max. temp. attained the value of $\leq 30.0^{\circ}$ C., increase of both



Crop condition : Vegetative to flowering
Disease intensity : Not reported



Crop condition : Pod formation
Disease intensity : Moderate to severe infection of Tikka leaf spot was reported from 7876 HA area of Nalgonda & Rangreddi districts

Figs. 3(a&b). Disease and crop information in two consecutive surveys in Andhra Pradesh

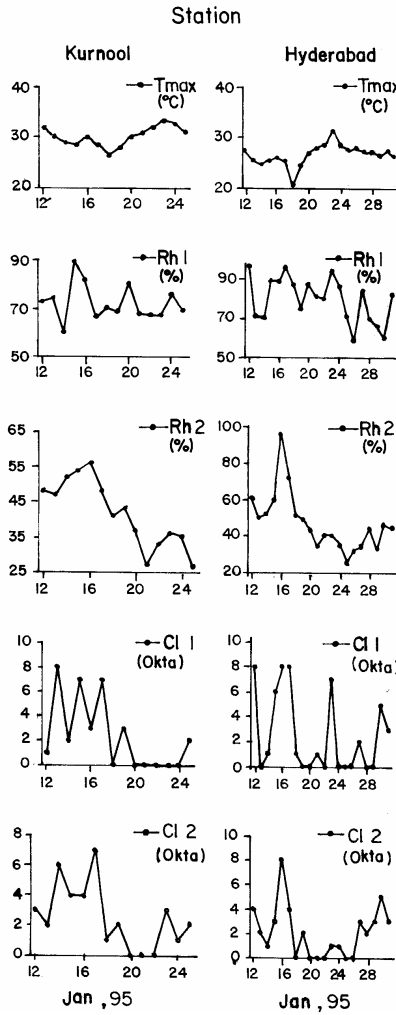
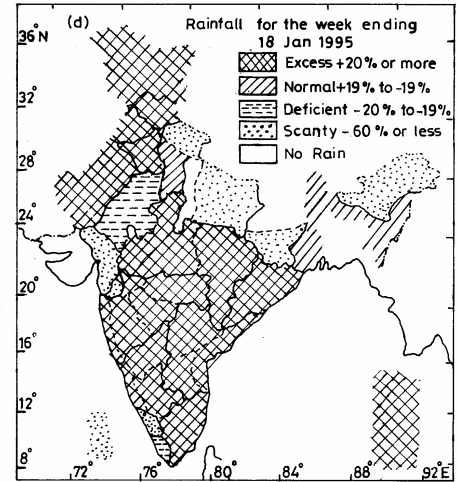


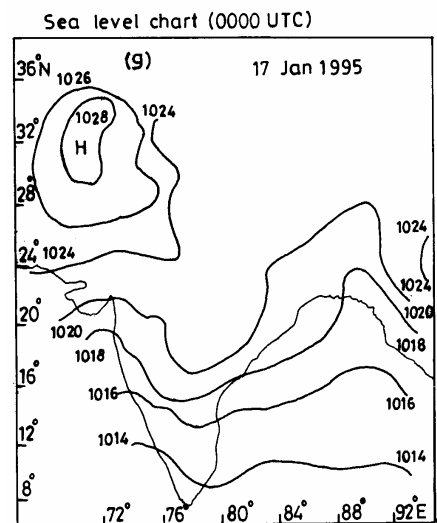
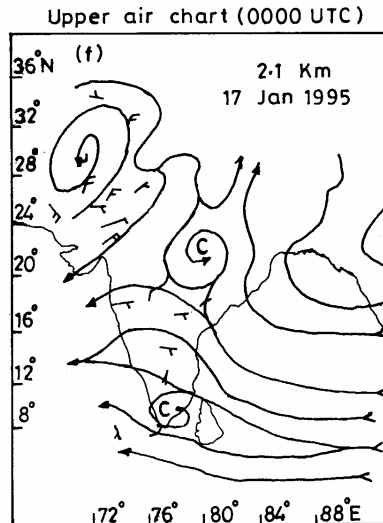
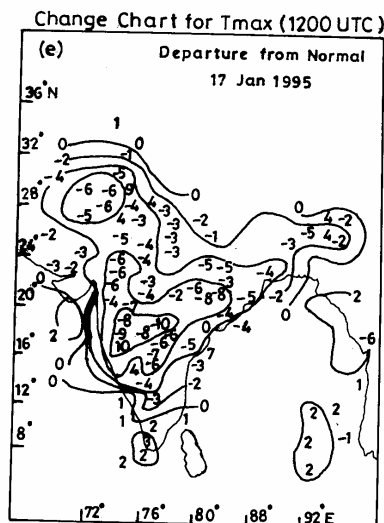
Fig. 3(c). Variation of meteorological parameters during the period of disease incidence



Principal amounts of rainfall (cm)

Date	Place	Rainfall
12	Narsampet	7
12	V. Pattnam	6
12	Kurnool	3
13	Kurnool	1
14	Kurnool	9
17	Tirupati	5

Fig. 3(d). Rainfall during the period of disease incidence



Figs. 3(e-g). Synoptic situation during the period of disease incidence

TABLE 1
Variations of meteorological parameters during the period of incidence of leaf spot

Station	Period of disease incidence	Tmax (°C)		R _{h1} (%)		R _{h2} (%)		Average clouding (okta)
		From	To	From	To	From	To	
Anand	1-10 Oct, 1988	36.0 (Sep 20)	28.4 (Sep 25)	78 (Sep 19)	100 (Sep 23)	47 (Sep 18)	98 (Sep 22)	*NA
Nawasari	1-10 Oct, 1988	34.0 (Sep 15)	29.2 (Sep 23)	77 (Sep 17)	98 (Sep 23)	50 (Sep 17)	88 (Sep 23)	*NA
Nagpur	22-28 Aug, 1989	34.3 (Aug 12)	28.2 (Aug 14)	86 (Aug 11)	90 (Aug 13)	62 (Aug 10)	83 (Aug 12)	6-8
Amravati	22-28 Aug, 1989	33.5 (Aug 12)	29.0 (Aug 14)	83 (Aug 11)	91 (Aug 13)	64 (Aug 10)	80 (Aug 12)	4-8
Khammam	1-13 Feb, 1998	32.0 (Jan 17)	29.0 (Jan 20)	80 (Jan 18)	90 (Jan 20)	40 (Jan 17)	60 (Jan 20)	2-4
Nizamabad	1-13 Feb, 1998	34.0 (Jan 16)	29.0 (Jan 20)	65 (Jan 18)	80 (Jan 20)	15 (Jan 16)	60 (Jan 19)	4-7
Ramagundam	1-13 Feb, 1998	33.0 (Jan 16)	29.0 (Jan 21)	80 (Jan 17)	85 (Jan 21)	50 (Jan 16)	65 (Jan 19)	2-7

* NA : Data not available

morning and afternoon humidity increased up to 80% or 60% or more respectively under partly to fully cloudy (2-8 oktas) and rainy condition caused the disease incidence. The synoptic situation over the area or in the neighbouring region was also favourable for the disease incidence.

The results emerged out from the above study were validated with the observation made in 1998. In this year disease was reported in Khammam, Nalgonda, and Rangareddy of Andhra Pradesh districts by the survey carried out from 1-13 February 1998. During this period too a sudden drop in maximum temperature and increase in relative humidity and clouding during the period of incidence. (Table 1) was reported. During this period a severe cold wave condition prevailed in west Madhya Pradesh, Marathwada and Vidarbha region of Maharashtra. Under the influence of cold wave in the above regions there was a decrease in temperature in parts of Andhra Pradesh. Besides, embedded cyclonic circulation over Telangana and neighbourhood caused rainfall in different places of Andhra Pradesh. Thus, observed findings validates fairly well with the observations made in 1998.

4. Conclusion

Leaf spot is a major disease of groundnut grown both as kharif and rabi crop in the country. Telangana and Rayalaseema subdivision of Andhra Pradesh, southeast Rajasthan, southern part of Gujarat, both south and north

interior Karnataka and Vidarbha region of Maharashtra have been identified as prone zone where the disease can appear on groundnut in epidemic form under favourable weather condition. By analysing the variations of meteorological variables during the disease incidence at different locations of the country, following meteorological criteria were established for the occurrence of the disease in moderate to severe condition.

- (i) Decrease in maximum temperature by 3.0° C or less and when attained maximum temperature 30.0° C or less.
- (ii) Increase in morning and afternoon relative humidity to 80% and 60% respectively.
- (iii) Partly to fully cloudy condition (2-8 okta) associated with rainfall.
- (iv) The above fluctuations of meteorological variables can be anticipated from the synoptic situation prevailed over the areas and neighbourhood region.
- (v) These information could be used as a tool to frame advisories for timely operational crop protection of leaf spot disease on groundnut through Agromet Advisory Service bulletin issued weekly / biweekly from the different National Meteorological Centres, Extension Wing of the Agricultural Universities located in the groundnut growing areas of the country.

Acknowledgements

The Authors are thankful to Dr. H. P. Das, Director (Agrimet) and also looking after the current duties of the Deputy Director General of Meteorology (Agrimet) for providing necessary facilities and encouragement. Grateful thanks are also due to the Director, PPQ & S, Faridabad for providing the Rapid Roving Survey Report. The authors are also thankful to S/Shri P. S. Ravindra and P. V. Kamble for helping in data analysis.

References

- Chohan, J. S., 1974, "Recent advances in disease on groundnut in India", In Current trend in Plant Pathology, Botany Dept., Lucknow Univ., 171-181.
- Dubey, R. C., Thorat, P. G. and Wadekar, S. N., 1995, "Climatic factors favourable for infestation of tikka disease on groundnut at Akola", *Mausam*, **46**, 450-452.
- Jackson, C. R. and Bek, D. K., 1969, "Disease of peanut (groundnut) caused by fungal:", University of Georgia, Agricultural Experimental Station Research Bulletin 56.
- Jensen, R. E. and Boyle, L. W., 1965, "The effect of temperature, relative humidity and precipitation on peanut leafspot", *Plant Disease Repr.*, 975-978.
- McDonald, D. and Fowler, A. M., 1977, "Control of Cercospora leaf spot of groundnut in Northern Nigeria:Importance of seed quality", *Nigerian Journal of Plant Protection*, **1**, 52-57.
- Ramakrishnan, V. and Appa Rao, A., 1968, "Studies on the tikka disease of groundnut", *Indian Phytopaths.*, **21**, 31-36.
- Smith, D. H. 1986, "Disease forecasting method for groundnut leaf spot disease", In Agrometeorology of groundnut, Proceedings of the International Symposium, ICRISAT Sahelian Center, Niamey, Niger, 21-26 August, 1985.
- Subramanyam, P. and Ravindranath, V., 1988, "Fungal and nematode disease in groundnut", Publication and information division, Indian Council of Agricultural Research, Krishi Anusandhan Bhavan, Pusa, New Delhi.
- Sulaiman, M. and Agashe, N. G., 1965, "Influence of climate on the incidence of tikka disease of groundnut", edited by P. S. Reddy, Publication and Information Division, Indian Council of Agricultural Research, Krishi Anusandhan Bhavan, Pusa, New Delhi.
- Sundaraman, N. V., 1965, "Note on creation of tikka leaf spot of groundnut", *Indian Oilseeds J.*, **9**, 98-101.
- Venkatraman, S. and Kazi, S. K., 1979, "A climatic disease calendar for tikka of groundnut", *Journal of Maharashtra Agricultural University*, **4**, 91-94.