

## The role of meteorological parameters on the infestation of rust and leafminer of groundnut at Akola

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(Received 10 August 1994, Modified 17 April 1996)

सारा—अकोला, महाराष्ट्र में मूंगफली की पर्णसुरंगी (लीफमाइनर) और किट्ट की समस्या पर मौसम विज्ञानिक प्राचलों के प्रभाव का अध्ययन किया गया है। किट्ट और पर्णसुरंगी के साथ मौसम विज्ञानिक प्राचलों के परस्पर संबंध का मूल्यांकन करने के लिए आलोक्षीय तथा सांख्यिकीय दोनों विधियों का साधन के रूप में प्रयोग किया गया है। यह पाया गया कि किट्ट का आक्रमण मूंगफली के पकने की अवस्था में होता है जबकि पर्णसुरंगी का आक्रमण मूंगफली के बनने से लेकर इसके पकने की अवस्था तक होता है। न्यूनतम तापमान सापेक्ष आर्द्रता में कमी तथा कुछ दिन पूर्व धूप के घंटों में वृद्धि के कारण किट्ट के आक्रमण में वृद्धि होती है। आर्द्र एवं चिलचिलाती धूप के कारण अधिकतम तापमान में वृद्धि से पर्णसुरंगी के आक्रमण में वृद्धि होती है।

**ABSTRACT.** Effect of meteorological parameters on the incidence of rust and leafminer of groundnut at Akola, Maharashtra is studied. Both graphical and statistical methods are used as tools for evaluating correlation of meteorological parameters with rust and leafminer. It is found that rust infestation occurs in the pod ripening stage, whereas leafminer attack extends from pod formation to pod ripening stage of groundnut. Decrease of minimum temperature, relative humidity and increase of sunshine hours a few days back increases rust infestation. Increase in maximum temperature in humid and bright sunshine condition helps to raise leafminer population.

**Key words** — Rust, Leafminer, Intensity of infestation, Statistical analysis.

### 1. Introduction

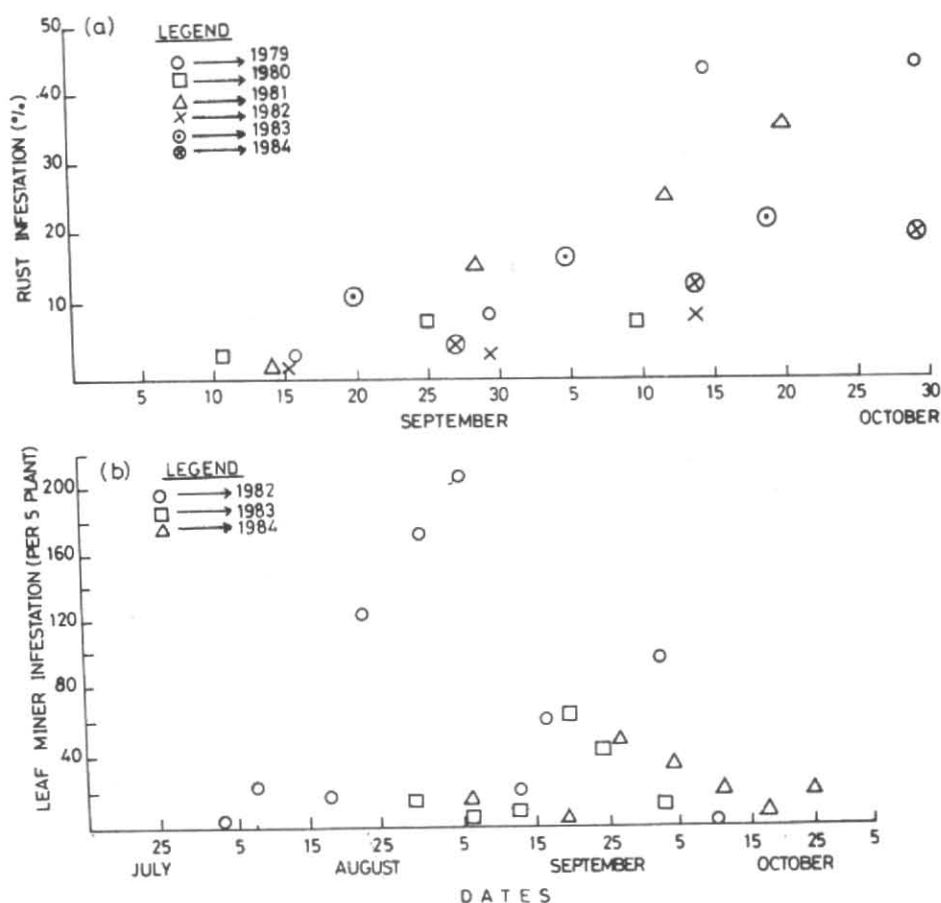
Rust (*Puccinia arachidis Spegazzini*) of groundnut was first reported from Punjab in 1969 (Chahal and Chohan 1971) and afterwards it was observed in Tamil Nadu and West Bengal (Rangaswami 1975). Now it occurs in most groundnut growing states of India (Mayee *et al.* 1977). The disease is particularly important in southern India where groundnut is grown for most of the time during the year and where conditions are favourable for development and spread of pathogens (Subramanyam and McDonald 1982). Under favourable conditions, disease spreads continuously throughout the season and may lead to almost total failure of crop. Congenial weather seems pre-requisite for widespread field infestation (Wells 1962, Zhou *et al.* 1980). Krishna Prasad *et al.* (1979), Siddaramaiah *et al.* (1980) and a number of workers have worked on the relationship of temperature, humidity and rainfall with the infestation of rust of groundnut.

In India, at present the most damaging pest of groundnut is leafminer (*Approaerema modicella Deventer*). The rainfed as well as irrigated groundnuts are infested by the leafminer in the country

indicating that the insect is capable of breeding throughout the year. Leafminer was endemic to south India but now appears to be a pest of economic importance in Maharashtra and potential pest in Gujarat because several crops of groundnut are grown sequentially throughout the year (Reddy 1988). The results of nine trials conducted under the All India Coordinated Research Project on Oilseeds have indicated that there was an average avoidable loss of 49 per cent due to leafminer infestation in south India (AICORPO, 1977-82). The rainfed groundnut suffers the maximum damage from July to August and the irrigated crops during February to May in south India (Nair 1975). Several workers (Barber 1906, Cherian and Basheer 1942, Narayanan 1962) have studied the effect of meteorological parameters on the infestation of leafminer of groundnut.

In order to explore the feasibility of forewarning of both rust and leafminer on rainfed groundnut grown at Akola, Maharashtra, an attempt has been made in this paper to investigate the meteorological factors responsible for rust and leafminer attack and to relate meteorological parameters like rainfall, maximum temperature, sunshine hours and relative humidity both at

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Figs. 1 (a & b). (a) Fortnightly infestation of rust and (b) weekly infestation of leafminer in different years

morning and afternoon with the intensity of pest and disease.

## 2. Material and method

The entomological data on rust and leafminer recorded from the control plots in the farm of the Punjabrao Krishi Vidyapeeth, Akola ( $24^{\circ}42'N$ ,  $77^{\circ}02'E$ ) were used in the present study. Rust infestation per cent was recorded fortnightly for six years, *i.e.*, from 1979 to 1985, whereas population of leafminer on five plants was collected weekly for three years (1982 to 1985) from groundnuts grown during kharif season. The groundnut was grown rainfed; it was sown either in the first or second week of July. The daily data of maximum temperature (TMAX), minimum temperature (TMIN), sunshine hours (SSH), rainfall (RFL), relative humidities at 0730 IST (RH-1) and 1430 IST (RH-2) were recorded in the Agromet Observatory of the farm. In all the years under study, the variation of the different meteorological parameters for each entomological

observation was critically analysed graphically and by correlation technique. Both simple and multiple correlation coefficients ( $r$ ) between the various meteorological parameters and infestation of rust and leafminer were calculated. Appearance and intensity of pest or disease may not be due to one or two days' sudden increase or decrease of a particular meteorological parameter; on the contrary it may be due to the accumulated effect of a particular parameter for several consecutive days before infestation of rust and leafminer is observed (Miller 1953). Therefore, determination of optimum period of presence of any meteorological condition responsible for infestation is necessary. For this reason correlation coefficients between rust and leafminer infestation and mean of consecutive two to seven days value of each parameter before the date of observation of rust/leafminer was also evaluated. Significant correlation at 5 per cent level between the intensity of rust/leafminer and the meteorological parameters was tested as per the statistical Table VI of Fisher and Yates (1938). The values of multiple correlation

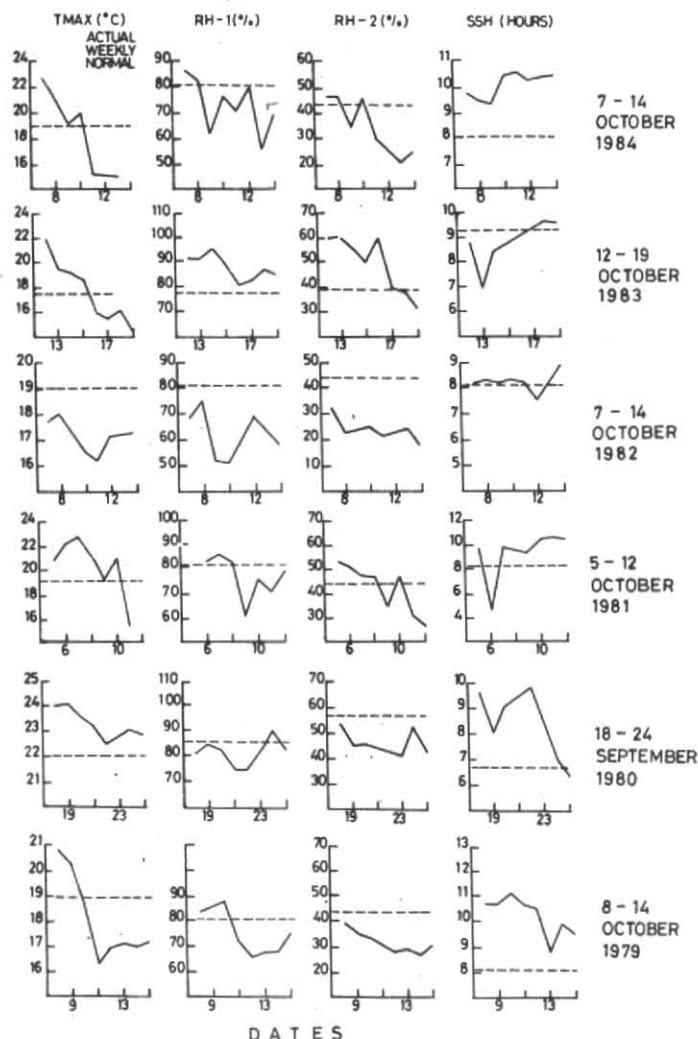


Fig. 2. Variation of meteorological parameters during seven days before major infestation of rust

coefficients were found to be low and insignificant even at 10 per cent level. Therefore, the multiple correlation coefficients are not included in the following discussion.

### 3. Result and discussion

The temporal variation in the relative infestation of rust in different years is presented in Fig. 1 (a). It was seen that in all the years under study appearance and maximum infestation of rust occurred in between 10-20 September and 15-25 October respectively. Thus, the infestation of rust was seen only in pod ripening stage of groundnut. In 1980 and 1982 the relative infestation was low and maximum infestation occurred between 10-15 October in 1982 and from last week of September in 1980, whereas in the remaining years substantial infestation (20-45%) was observed. In all these years maximum infestation occurred after mid

October. Highest infestation was recorded in 1979 followed by the years 1981, 1983 and 1984.

Fig. 1 (b) shows intensity of leafminer population (average of five plants) on different dates after its appearance. In 1982 infestation of leafminer started on 3 August, whereas in the years 1983 and 1984 it appeared on 30 August. In 1982, a sharp change of leafminer population was observed from 20 August and 20 September; on the other hand, in 1983 and 1984 it was seen from 15 and 20 September respectively. The period of infestation of leafminer thus extended from the pod formation to the pod ripening of groundnut.

Fig. 2 shows the variation of different meteorological parameters during seven days before sharp change of rust infestation, *i.e.*, when the difference between two consecutive fortnight observations of relative rust infestation was

TABLE 1

Correlation coefficients between daily meteorological parameters and infestation of rust significant at 5% level

Meteorological parameters	Day before appearance of rust						
	1	2	3	4	5	6	7
TMIN	—	—	—	-0.65	-0.57	-0.48	-0.61
RH-1	-0.49	—	-0.44	—	—	—	—
RH-2	-0.55	—	—	-0.41	—	—	—
SSH	—	—	0.46	—	0.48	—	—

TABLE 2

Correlation coefficients between mean meteorological parameters and infestation of rust significant at 5% level

Meteorological parameters	Mean of the consecutive days values before appearance of rust					
	2	3	4	5	6	7
TMIN	-0.49	-0.47	-0.53	-0.55	-0.57	-0.59
RH-1	-0.56	-0.53	-0.47	—	—	—
RH-2	-0.51	-0.48	-0.49	-0.46	-0.46	-0.46
RFL	—	-0.47	—	—	—	—

sufficiently high. The inter-relationship between rust infestation and different parameters is discussed below.

TMIN was observed to fall during the period of observation, but during the study period it fell well below the normal weekly TMIN and was 16.3°C or below (except in 1980) before rust infestation was observed to occur. Correlation studies indicate that the rust infestation was negatively correlated with the minimum temperature observed 4 to 7 days before infestation (Table 1). Highest negative correlation was observed between the % rust infestation and TMIN four days before. Mean of the seven days TMIN had highest negative correlation with rust infestation (Table 2) although the mean of two to six days' period to TMIN temperature was also negatively correlated with the rust infestation. Thus, it appears that decrease of minimum temperature has a direct bearing on rust infestation.

It has been observed that before the rust infestation to occur, the RH-2 should show trend similar to TMIN. On the average, RH-2 reached a minimum of 20 to 40% within a week before the infestation.

Infestation of rust was negatively correlated with the RH-2 one and four days before observation. Highest correlation of  $r = -0.55$  was observed between rust infestation and relative humidity one day before the observation. Average of 2-7 days' RH-2 before the infestation was negatively correlated and it was significant at 5% level.

The RH-1, 7 days before the day of infestation was not so regular as TMIN and RH-2. But on the whole, in all the years before rust infestation, the value of RH-1 gradually decreased, minimum was 50 to 75% (except in 1983 when RH-1 was > 80%). Significant negative correlations were observed between the rust infestation and RH-1 one and three days before infestation. Highest negative correlation of  $r = -0.49$  was noted between rust infestation and RH-1 observed one day before infestation. Thus decrease of relative humidity (both morning and afternoon) helps to increase rust infestation.

No regular trend was established for sunshine duration before rust infestation. Its values were generally high (> 7.5 hrs/day) in all the days during

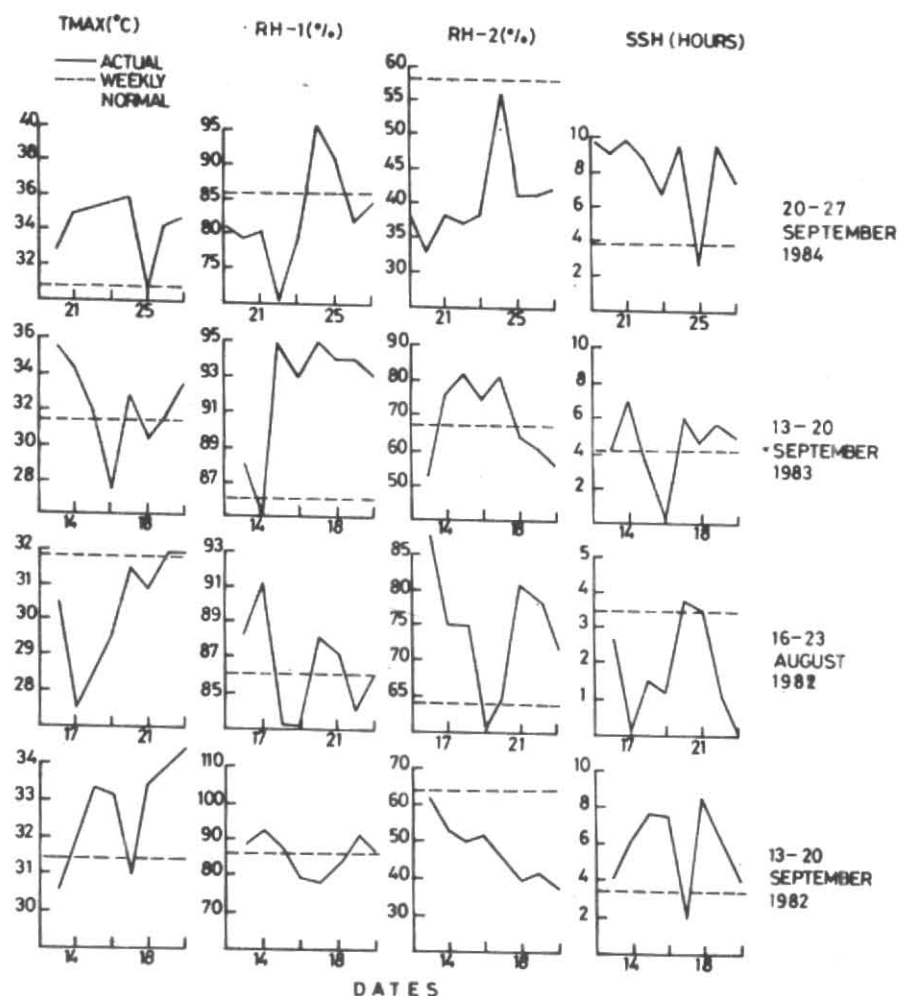


Fig. 3. Variation of meteorological parameters during seven days before major infestation of leafminer

the week before the infestation occurred except a few days in 1979, 1980 and 1983 which happened to be cloudy days. A 9.8 and 5.4 mm rainfall was recorded on 14 October 1983 and 23 September of 1980 respectively. Sunshine duration 3 and 5 days' prior to infestation was significantly correlated with the extent of rust infestation. Highest positive correlation ( $r = 0.48$ ) has been observed between % rust infestation and sunshine hours 5 days prior to infestation. Rust infestation and sunshine duration were related because multiplication of disease on the leaf surface of groundnut was more in the presence of bright sunlight.

From the foregoing discussions it can be inferred that, in general, the decrease TMIN and RH-2 for a seven-day period encourages rust infestation in groundnut crop. Decrease of RH-1 and an

increase of sunshine duration three and five days before the infestation also favours the rust incidence in kharif groundnut.

The change of different meteorological parameters within seven days prior to sharp rise in leafminer population in different years is presented in Fig. 3. In all the years under study it has been noticed that within a week's time initially there was a rapid fall of TMAX ( $\leq 31^\circ\text{C}$ ), RH-1 ( $\leq 85\%$ ) and SSH ( $\leq 3$  hrs) below normal value. Afterwards, these parameters showed comparatively higher values (most cases above normal) before 1 to 3 days before infestation was observed. Though no regular trend in RH-2 was observed, it attained high value one to three days before infestation. It has also been noticed that within seven days' period prior to infestation, there occurred a good amount of rain. A

number of workers (Barber 1960, Cherian and Basheer 1942, Narayanan 1962) have also found that bright sunshine and occasional rainfall encourage leafminer population. No significant correlation is observed between sunshine and rainfall with that of leafminer population. Thus from the variation of leafminer population with the different meteorological parameters observed in all the years under study, it may be mentioned that within week's time initial decrease in TMAX, RH-1 and SSH below normal and subsequent increase of these parameters above normal just before one to two days before infestation with occasional rain help to increase the population of leafminer to a great extent.

#### 4. Conclusions

The main conclusions of the study are as follows:

- (i) Rust infestation occurs from 2nd to 4th week of September and reaches maximum value from 2nd to 4th week of October at Akola. These periods correspond to pod ripening stage of groundnut.
- (ii) In case of leafminer the period of appearance and cessation of pest is seen from the month of August to October which covers the pod formation and pod ripening stages of groundnut grown at Akola.
- (iii) Low temperature (16.3°C), low relative humidity (RH-1: 20 to 40 percent; RH-2: 50-75 percent) and high sunshine (7.5 hrs/day) appear to be main controlling factors for the infestation of rust on groundnut.
- (iv) Within week's time initial decrease of TMAX, RH-1 and SSH below normal and subsequent increase of these parameters above normal just before one to two days before infestation with occasional rain help to increase the population of leafminer to a great extent.

#### Acknowledgements

Authors are grateful to the Additional Director General of Meteorology, Division of Agrometeorology for providing facilities for carrying out this work. Authors are also thankful to Shri J. D. Kale for assisting in tabulation and analysis work.

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