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Influence of meteorological parameters on the jassid infestation on cotton at Akola

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सार — महाराष्ट्र के अकोला में 1979 से 1992 तक के 14 वर्षों के आँकड़ों की सहायता से कपास को प्रभावित करने वाले जैसिड कीट की जनसंख्या (एमरास्का बिगुतुला बिगुतुला इशीदा) पर विभिन्न मौसम वैज्ञानिक प्राचलों के प्रभाव का अध्ययन किया गया है। अध्ययन के अन्तर्गत आने वाले वर्षों में जुलाई के अन्तिम सप्ताह से लेकर अक्तूबर के दूसरे सप्ताह तक जैसिड कीट सक्रिय रहा है। 32 वें तथा 37 वें सप्ताह में दोपहर तथा सुबह की सापेक्षिक आर्द्रता में कमी तथा 36 वें सप्ताह में न्यूनतम तापमान में वृद्धि इस कीट के विकास के लिए अनुकूल पाई गई है। दो सप्ताहों के बाद 39 वें सप्ताह में मेघाच्छन्न मौसम के कारण भी जैसिड कीट की जनसंख्या में वृद्धि हुई है। 36 वें सप्ताह में न्यूनतम तापमान 22.4°C से अधिक वाला मौसम जैसिड कीट के अचानक प्रकोप के लिए सर्वाधिक अनुकूल पाया गया है। अकोला क्षेत्र में कपास के जैसिड कीट के प्रकोप की पूर्व चेतावनी देने के लिए जैसिड मौसम कैलण्डर का उपयोग किया जा सकता है।

ABSTRACT. Influence of different meteorological parameters on jassid *(Amrasca biguttula biguttula Ishida)* population on cotton at Akola, Maharashtra was studied with 14 years data from 1979 to 1992. Jassid remained active from last week of July till second week of October in the years under study. Fall in afternoon and morning relative humidities respectively at 32nd and 37th week and increase in minimum temperature at 36th week favoured pest development. Cloudy weather at 39th week also increased jassid population after two weeks. Minimum temperature ≥ 22.4°C at 36th week was found to be the most predominant weather parameter influencing sudden increase in jassid infestation. Jassid weather calendar of cotton could be used for early warning purposes in the Akola region.

Key words — Meteorological parameters, Jassid population, Cotton, Pest Weather Calendar.

1. Introduction

Jassid is one of the destructive pests in the cotton-pest complex. It is widely distributed in India and causes more damages to cotton crop in the north-western region. Owing to the incidence of jassid, plants lose vitality, the cotton bolls also drop off, causing upto 35 percent reduction in yield (Atwal 1986). Vidarbha region is the chief cotton growing area of the Maharashtra state. The average yield per acre in this region is comparatively low compared to the other cotton growing areas of the country, mainly because cotton is heavily infested by jassid and other pests right from seedling to maturity (Borle *et al.*1980).

In general, insecticides are applied in excess at random to control the jassid population on cotton. Excessive use of the noxious chemicals not only causes economic restrains on the farmers but also produces harmful side effects on environment especially to the ground water and natural enemies present in the soil. A feasible solution to this vexed problem is the timely use of required amount of insecticides on the crop. This will not only increase cotton crop production but also minimise environmental pollution. This is possible through the knowledge of existing inter-relaionship between jassid population and favourable meteorological parameters. Keeping in view the above facts, an attempt has been made in this paper to investigate the relationship between jassid population and a few meteorological elements, like weekly total rainfall, mean maximum and minimum temperatures, mean relative humidity (both morning and afternoon) and mean sunshine hours.

2. Data and methodology

The quantitative pest data for jassid for 14 years (1979-92) were collected from the Department of Entomology, Punjabrao Krishi Vidyapeeth, Akola (24° 42′N, 77° 02′E). Observations of jassid on cotton were recorded in one block in the experimental plot of the University which was kept under natural conditions for recording observations of jassid infestation. No insecticide was applied in the control experimental plot throughout the crop growing period.

The observations were recorded at weekly interval on plants, randomly selected in block. Three leaves per plant were selected from the top, middle and lower portion for the pest observation. The daily meteorological parameters -

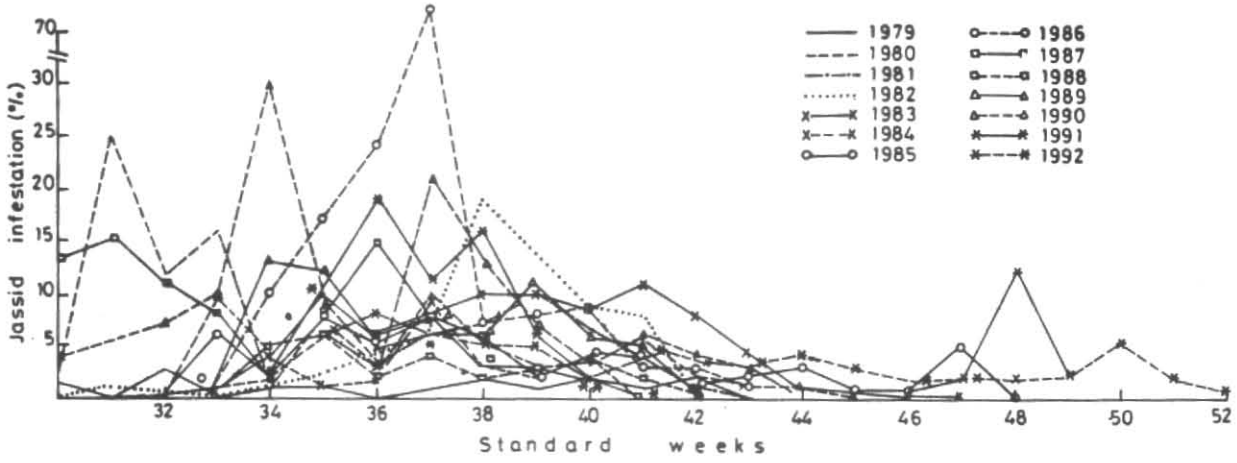

Fig.1. Jassid infestation at different weeks in different years

rainfall (RFL), sunshine hours (SSH), maximum (TMAX) and minimum (TMIN) temperatures and humidity both at 0700 LMT (RH-1) and 1400 LMT (RH-II), averaged over different standard meteorological weeks were used in the present study.

As the previous week's meteorological parameters also equally influence the development of the pest, therefore meteorological parameters for at least two weeks before the infestation was considered to study the influence of weather parameters on the out-break of the pest. The correlation and regression studies between the jassid population and meteorological parameters were made as follows:

(a) Between the jassid population and meteorological parameters in the same week.

(b) Between the jassid population in a week and meteorological parameters in the previous week.

(c) Between the jassid population in a week and meteorological parameters in the previous to previous week.

Simple correlation coefficients were worked out between meteorological parameters and jassid population percent at different weeks. Student 't' test (Fisher and Yates 1938) was applied to test the significance of these correlations at different levels (5, 2 and 1% levels). Stepwise regression technique was used to workout the multiple correlation coefficients (M.C.C.) between jassid infestation and different meteorological parameters. Parameters having significant correlation at 5% level were subjected for further graphical analysis to examine the information generated by the statistical techniques. The plotted curves based on actual mean value of significant meteorological parameters were compared with normal meteorological parameters. (IMD 1991).

3. Results and discussion

The pest data for the years under study show that the jassid population on cotton was mainly confined (above 10%) between 32nd and 41st week (23rd July to 14th Oct) when cotton was either in elongation or flowering or initial boll formation stages. In general, jassid infestation percent did not exceed 25% in most of the years. However, in 1986 infestation was as high as 72% (Fig.1).

Correlation studies (Table 1) indicate that the different meteorological parameters individually influenced jassid population in different weeks. Jassid population in 33rd week was found to be negatively correlated with RH-II at 32nd week. It has been observed that rapid fall in RH-II (below 72%) from 31st week to 33rd week caused increase in jassid population at 33rd week. In 1980 and 1990, there was comparatively heavy rainfall in 31st week (20.6 mm and 30.6 mm rainfall respectively in 1980 and 1990) and resulted in high RH-II in this week. Subsequent decrease of rainfall in the succeeding weeks, *i.e.*, 32nd and 33rd resulting rapid fall in RH-II (81 to 72% in 1980 and 79 to 68% in 1990) favoured jassid infestation at 33rd week. Besides presence of a fewer jassid population at 32nd week in these years accelerated rapid multiplication of jassid pest. (Fig.2)

Minimum temperature showed positive correlation (r = 0.7, significant at 1% level) with the jassid population at 36th week. Both in 1986 and 1990, jassid population reached above 20% when TMIN attained the value of 23.4°C and 23.3°C respectively [(Fig.3), normal TMIN for 36th week: 22.4°C]. This findings are in consonance with the observation of Dubey and Throat (1994) who also found positive correlation between minimum temperature and jassid population on sunflower at Akola. The low infestation of jassid in 1985 may be attributed to the other biological factors, *viz*, parasite of predators which might have inhibited jassid population.

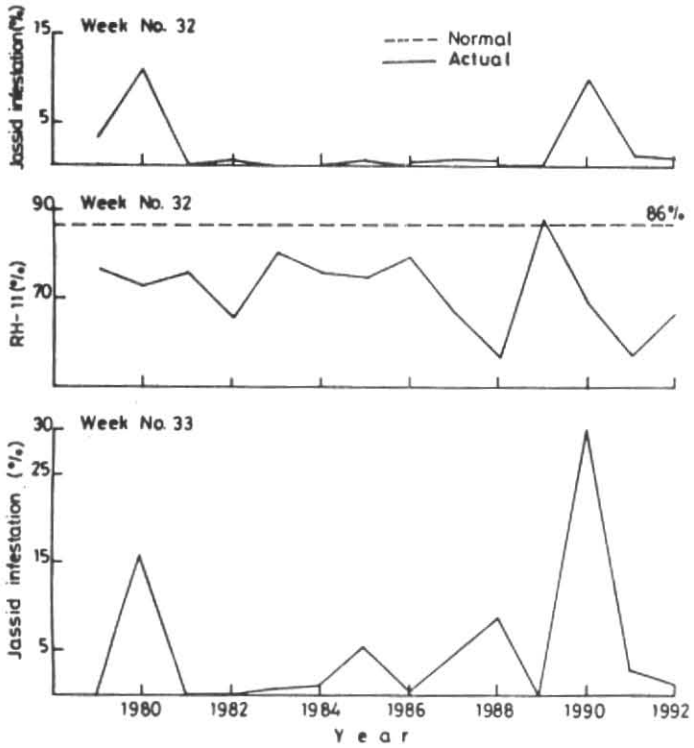

Fig.2. Jassid population at 33rd, 32nd week and afternoon relative humidity at 32nd week in different years

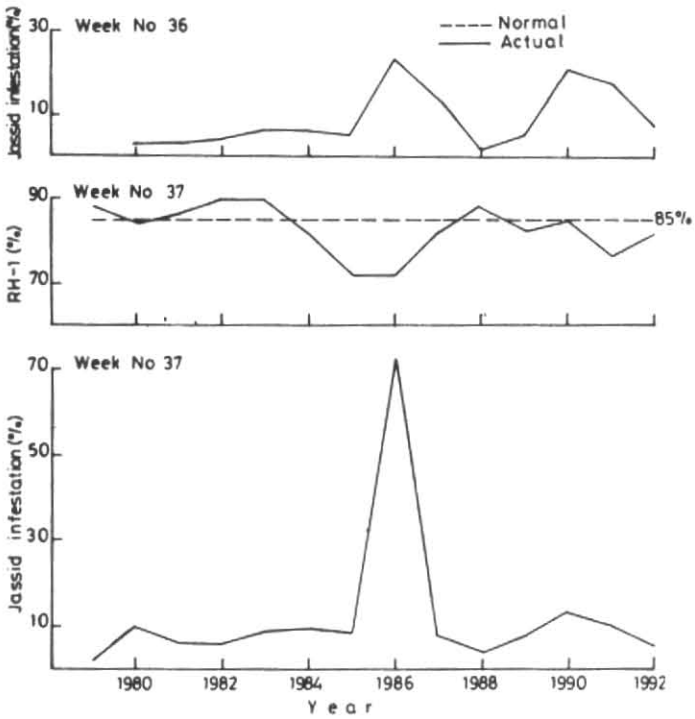

Fig.4. Jassid population and morning relative humidity at 37th week in different years

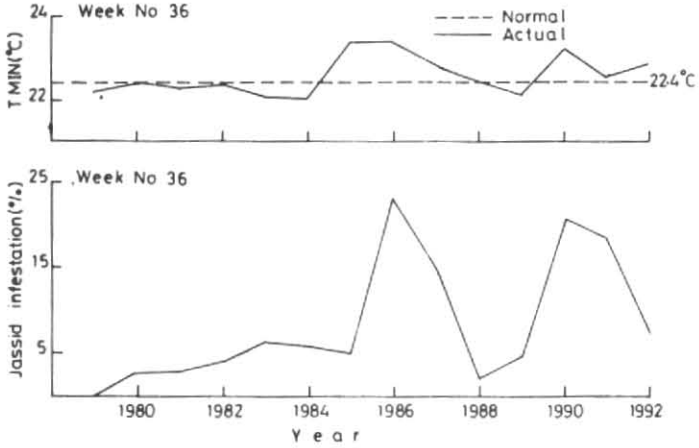

Fig.3. Jassid population and minimum temperature at 36th week in different years

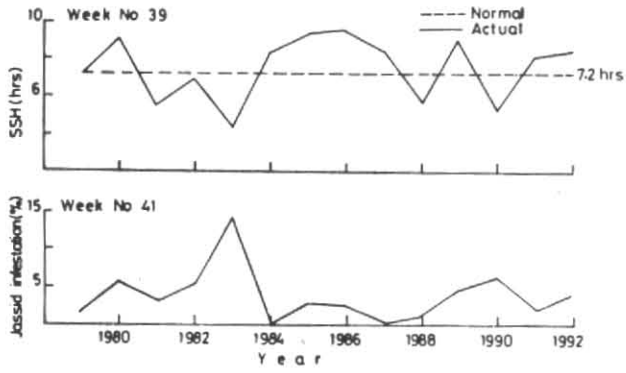

Fig.5. Jassid population at 41st week and sunshine hours at 39th week in different years

Morning relative humidity was found to be negatively correlated (r = -0.6) with the pest population at 37th week. Large jassid infestation (72%) in the same week may be due to the vigorous multiplication of jassid population at 36th week under favourable morning relative humidity (72%) at 37th week (Fig.4).

Effect of decrease in sunshine hours on jassid population is shown in Fig.5. Jassid population at 41st week was found to be negatively correlated with the sunshine hours at 39th week. As the life cycle of jassid ranges from 3 to 4 weeks, cloudy weather at 39th week helped breeding of jassid and after two weeks, *i.e.*, at 41st week adult came out in large numbers. Reduction in sunshine hours to 4.4 hours due to rainfall (8.7 mm) at 39 week in 1983 caused high infestation of jassid population at 41st week.

In order to develop forewarning model during the peak infestation period, *i.e.*, 36-41 week, the pest and meteorological for this period, i.e., 36-41 week were pooled and correlation coefficients were worked out between these two varibales. Significant correlations were observed with minimum temperature and relative humidity (both morning and afternoon) respectively at 36th and 37th week. With these three meteorological factors alongwith the jassid infestation, a regression model has been developed and presented in Table 2. Multiple correlation coefficient (0.70) accounted for 49.2% of total

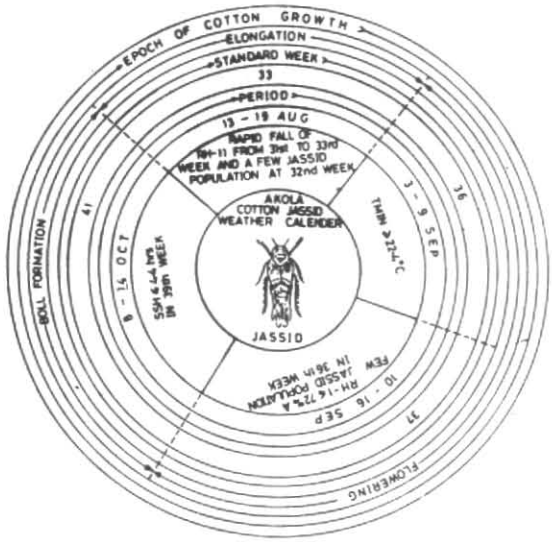

Fig.6. Jassid weather calendar

variation of jassid infestation. The model has been developed based on 12 years data. (1979 to 1990) and validated for the years 1991 and 1992. The observed average jassid infestation at 36th and 37th week was 14.7 and 6.7% respectively in the year 1991 and 1992. The corresponding estimated values obtained from the regression equation were 11.3 and 5.9%. The estimated jassid infestation narrowly under- estimates the pest population in both the experimental years. Thus, the model can be used for forewarning of jassid population on cotton at Akola. Among all the meteorological parameters the minimum temperature was the most predominant controlling factor for jassid infestation in 36th week and 37th week.

A pest weather calendar (Fig.6) has been prepared based on the results from the study for operational crop protection measure during the peak infestation period. From this calendar, it is possible to assess the infestation of jassid based on the real time data of meteorological parameters. Critical values of the meteorological parameters in a particular week favouring pest infestation were included in the diagram. This calendar alongwith the real time information on population density of jassid and current weather would help the agro-meteorologist/agricultural scientists to forewarn the farmers about the possible attack of the pest on cotton in and around Akola.

4. Conclusion

(*i*) 23rd July to 14th October was the peak infestation period of jassid when the crop was either in elongation or flowering or initial boll formation stages.

(*ii*) Rapid fall in afternoon relative humidity (below 72%) from 31st week to 33rd week due to the reduction in rainfall amount helped jassid infestation at 33rd week.

TABLE 1

Correlation coefficients (CCs) between the jassid infestation and meteorological parameters

Week No.	Meteorological parameters	CC	't' value significant at different levels(%) 5	1
32-33*	RH-II	–0.6	2.3	–
36	TMIN	0.7	–	3.1
37	RH-I	–0.6	2.4	–
39-41**	SSH	–0.5	2.3	–

*Week Nos. 32-33 indicates that jassid infestation percentage at 33rd week was correlated with the afternoon relative humidity of the previous week.

** Week No. 39-41 indicates that jassid infestation percentage at 41st week was correlated with the sunshine hours of the 39th week.

TABLE 2

Predominant meteorological parameters, regression equation and squares of the multiple correlation coefficient

Week No.	Predominant meteorological parameter	Regression equation	MCC^2 (%)
36	TMIN	$IC = -62.26+7.35X_1 -1.52X_2+0.62X_3$	49.16

X_1 - TMIN of 36th week, X_2 - RH-I of 37th week, X_3 - RH-II of 37th week.

(*iii*) Above normal minimum temperature (≥22.4°C) at 36th week in association with reduction in morning relative humidity (≤72%) at 37th week enhanced rapid infestation of the pest at 37th week.

(*iv*) Less sunshine hours or conversely more cloudy weather (≤4.4 hrs.) at 39th week favoured jassid population at 41st week.

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