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The incidence of sugarcane stemborer at Anakapalle in relation to some meteorological elements

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सार — गन्ने की फसल पर तना वेधक का जो प्रभाव होता है वह मौसम के विषयक कारकों पर निर्भर करता है, यह तथ्य सुविदित है। इसलिए, इसके आक्रमण के संबंध में मौसम सम्बंधी पूर्व चेतावनी की उपयुक्तता का पता लगाने के लिए अनाकापल्ले में से वर्ष 1967–1980 के कीट विज्ञान और मौसम विज्ञान संबंधी आंकड़ों का इस शोधपत्र में सांख्यिकीय विश्लेषण और विचार-विमर्श किया गया है। इसमें सरल और बहु रैखिक समाश्रयण संबंधी तकनीकों का प्रयोग किया गया है। भारत में लगभग 50 कृषि मौसम विज्ञान स्टेशनों से प्राप्त वर्ष 1954-1980 के पिछले गुणात्मक आंकड़ों पर आधारित तना वेधक के आक्रमणों से प्रभावित होने वाले अनुमानित क्षेत्र के निर्धारण का भी प्रयास किया गया है।

ABSTRACT. The dependence of stemborer incidences on sugarcane crop upon the meteorological factors is well recognised. Therefore, to explore the feasibility of meteorological forewarning of its attack, the statistical analysis of entomological and meteorological data for the years 1967-1980 from Anakapalle has been done and discussed in this paper. The simple and multiple linear regression techniques were used. An attempt is also made to delineate the approximate risky zone for stemborer attacks in India on the basis of qualitative pest data for the years 1954-1980 received from nearly 50 agrometeorological stations in India.

1. Introduction

Stemborers are potential pests of sugarcane. They cause three fold loss; acreage yield loss for cultivators, sugarcane yield loss for mill owners and revenue loss for Government. These are mainly confined to a particular locality or season. There are several species of borers damaging sugarcane in India which are present almost in all the cane growing areas (Butani 1961, Rao 1969). Though their infestations are recorded on other crops like bajra, barly, maize, sorghum and millet etc, yet sugarcane is their preferred host. The favourable meteorological conditions during moth emergence and egg-laying help in their rapid multiplications. Their attack in the early stage of the crop growth causes dead hearts where that in grown up canes, reduces cane yield and juice quality. The meteorological parameters like temperatures, relative humidity and rainfall etc, play an important role in the activity of pest pupal emergence and their profused multiplication.

In view of these facts, an attempt has been made in this paper to explore the feasibility of meteorological forewarning of stemborers (*Chilo-infuscatellus Shellen, Chiko auricilus Dudgeon*) attack on sugarcane at Anakapalle by investigating the relationship between the intensity of attack and the few meteorological elements during the entire crop life. It is seen from the "Crop Weather Calendar" for sugarcane at Anakapalle, *prepared in the Division* of Agricultural Meteorology, Pune, that the plantation to harvest period of sugarcane is from February/March to March/April of next year. The important epochs of the crop growth and months are : germination by March/April, tillering by April/May, vegetation by June to October and maturity by November to March of next year.

2. Materials and methods

The entomological data at fortnightly intervals and the meteorological data daily at 0700 and 1400 L.M.T. recorded at crop weather station, Anakapalle (17° 40′N, 83° 00′E) in Vishakhapatnam district during 1967-1980 were utilised in this study. The station had recorded incidences of stemborer in a qualitative way under three categories, *i.e.*, light, moderate and heavy, and reported as monthly average attack. Each category represents the ratio of the number of dead hearts to the total number of sugarcane plants in the sampling unit of the experimental field. The categories light, moderate and heavy indicate infestation of 25, 50 and 75 per cent respectively. The yearly univariate seasonal index of the pest attack was calculated as an average of the monthly incidences reported during the crop life, *i.e.*, from January-February to December-January.

These seasonal indices were correlated with the weekly means of maximum temperature (T_{max}), minimum temperature (T_{min}), bright sunshine hours (SSH), evaporation (EVPN), rainfall (RFL), morning relative

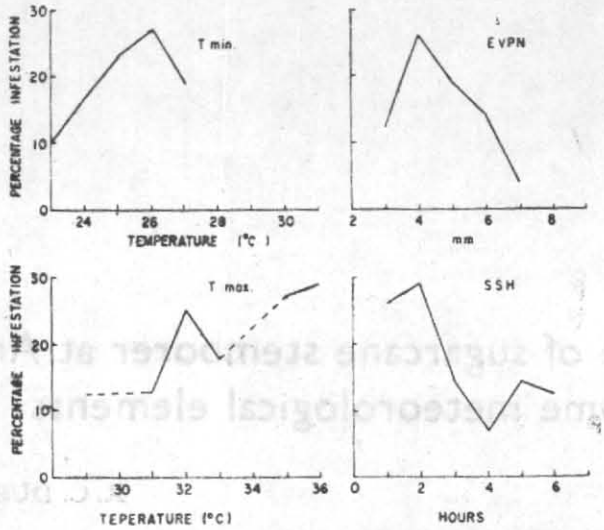

Fig. 1. Curves showing variation of the percentage infestation with T_{min} (32 Std. week), T_{max} (40 Std. week), EVPN (29 Std. week) and SSH (31 Std. week) in the weeks of highest CC values

humidity (RH-I) and evening relative humidity (RH-II) for every standard week separately by using simple linear regression technique. The correlation coefficients (CC) were calculated between the above mentioned elements and mean seasonal indices of the pest infestation. The student '*t*' test was also worked out to test for the statistical significance of correlations.

The weeks having highest correlation coefficient and statistically significant at 1 to 10% level were selected for individual parameters. Then a Multiple Correlation Coefficient (MCC) was also calculated using same meteorological parameters for selected weeks by multiple linear regression technique as adopted by Dubey *et al.* (1985). The MCC could be computed combining maximum number of 13 common years for T_{max}, RH-I, RH-II and RFL parameters only, because others were having data for lesser number of common years, and then a multiple linear regression equation was derived.

The values of average percentage infestation against different values of such meteorological parameter in the standard weeks of highest CC values were calculated and displayed in Fig. 1 by curves for T_{max}, T_{min}, SSH, EVPN and that of RH-I, RH-II and RFL in Fig. 2 by histograms. The average frequencies of infestations at Anakapalle were calculated monthwise for the full life span of the crop combining all the categories of incidences during 1967-1980 and shown in Fig. 3 to draw an idea of the favourable months of attack and the growth stage of sugarcane.

Qualitative data on the attacks of sugarcane stemborers were recorded at nearly fifty agrometeorological stations under "All India co-ordinated crop weather scheme", since 1954 under three categories, *i.e.*, light, moderate and heavy, by the same method as at Anakapalle. At each station, the frequency of attacks of each intensity was calculated from the number of attacks reported out of the total number of observations during 1954-1980. The only stations reporting heavy attack of the frequency $\geqslant 10\%$, moderate of the frequency $\geqslant 20\%$ and that of light attack $\geqslant 25\%$ were selected out arbitrarily to have an uniformity in the procedure adopted in earlier work (Dubey 1984). The areas favourable to the attack of different intensities were estimated and discussed.

3. Results and discussion

It was found that duration of sunshine in 31st standard week (*i.e.*, 30 July to 5 August) has got the highest correlation coefficient 0.73868 with '*t*' value 3.29 for 11 years data significant at one per cent level, with the pest infestation. Although computing correlation coefficients in terms of physiological stages of the crop may be more meaningful rather than standard meteorological week, but the availability of the pest data in terms of standard week was the main reason for adopting weekly parameters. Growth stages may be found in terms of standard week also. The others most significant parameters were minimum temperature of 32nd standard week (*i.e.*, 6 to 12 August) and rainfall in 15th week (*i.e.*, 9-15 April), with correlation coefficients 0.70997 with '*t*' value 3.19 for 12 years data and 0.70265 for 13 years data, respectively and both significant at one per cent level. Next significant parameters for 13 years data are T_{max} in 40th week (*i.e.*, 1-7 October), RH-II in 40th week and RH-I in 47th week (*i.e.*, 19-25 November) with correlation coefficient values of 0.65930, 0.58897 and 0.57974 respectively. These were significant at 5% level. Evaporation in 29th week (*i.e.*, 16-22 July) has got correlation coefficient value of 0.57975 with '*t*' value 2.13 for 11 years data and significant at 10 per cent level.

The most effective parameters in the early growth stage before node formation are rainfall in April. T_{min} and sunshine hours in July-August. Rainfall upto 10 mm (Fig. 2) in a week during April is favourable for larva instars to bore inside the early shoots. More rainfall may wash away the larva feeding on outer seaths. The evaporation of 4 mm and T_{min} of 26°C in middle of August are congenial (Fig. 1). This is the elongation or vegetative phase of the crop, when node

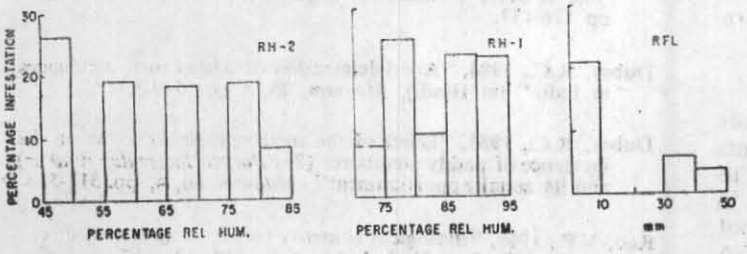

Fig. 2. Histograms showing variation of the percentage infestation with RH-2(40 Std. week), RH-1 (47 Std. week) and RFL (15 Std. week) in the weeks of highest CC values

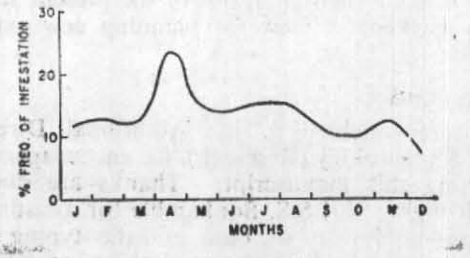

Fig. 3. Monthly variation of average percentage frequency of infestation at Anakapalle

formation also takes place. The larvae are inside the stem and feeding gregariously. After few days they may come out and migrate to other canes of the same clump. As a result the leaves start drying and ultimately the whole whorl dries up. During last week of July the sunshine of nearly 2 hours a day is favourable for their activity. In the first week of October the maximum temperature of 32°C and higher than 35°C with evening relative humidity of 60-65% are favourable for its infestation.

The multiple linear regression equation between seasonal indices of infestation and only four weather parameters for which maximum common 13 years data were available was derived and expressed as below :

$$Y = -181.8579 + 4.444\ X_1 + 0.327\ X_2 + 0.454\ X_3 - 0.226\ X_4$$

with $t_{X1} = 2.91$, $t_{X2} = 2.36$, $t_{X3} = 2.42$ and $t_{X4} = 3.28$

where,

Y = Estimated value of percentage infestation.

X_1 = Weekly mean value of T_{max} in 40th standard week.

X_2 = Weekly mean of morning relative humidity in 47th standard week.

X_3 = Weekly mean of evening relative humidity of 40th standard week.

X_4 = Weekly mean of rainfall in 15th standard week.

With the help of this statistical regression equation, it may be possible to estimate the percentage infestation at the station under the limitations of the data used in this statistical studies. The multiple correlation coefficient of these parameters was found to be 0.87 which accounted for 76% of total variation in the infestation of stemborer on sugarcane at Anakapalle.

The highest attack in sugarcane at Anakapalle was found in April (Fig. 3). These were due to early shoot borers. The second hump in the curve was seen in July-August. Thus in the period of elongation stage when the nodes were fully formed, the attack of stalk-borers under favourable conditions were found.

The major sugarcane growing areas in India are Uttar Pradesh, Haryana, Punjab, Bihar plains, Maharashtra, Tamil Nadu, parts of north West Bengal, coastal Andhra Pradesh and Orissa (*Indian Agricultural Atlas*, Directorate of Economics and Statistics). But the attacks of different intensities were found in certain parts of these growing regions. The heavy attacks were recorded in eastern parts of Marathwada with adjoining Telangana, central part of coastal Andhra Pradesh and eastern parts of Bihar. The moderate attacks were in the parts of west Uttar Pradesh, Bihar plains and north of West Bengal, where as the light attacks were spread over Madhya Maharashtra, interior Andhra Pradesh, parts of west Uttar Pradesh and Bihar plains. This study may help to make an advisory to farmers of concerned regions to take suitable precautionary measures to control the attack of this pest in proper growth stage of the sugarcane crop.

4. Conclusion

The main conclusions of this study are :

(*i*) T_{min}, SSH and RFL have highest CC, hence may be predominant controlling factors for stemborer infestations at Anakapalle. The optimum values are T_{min} 26°C in 2nd week of August, bright sunshine of 2 hours in first week of August and weekly rainfall of 10 mm in middle of April.

(*ii*) April is the most probable month of stemborer attack at Anakapalle.

(*iii*) Eastern part of Marathwada with adjoining part of Telangana, central part of coastal Andhra Pradesh and eastern parts of Bihar are areas prone to heavy attacks of stemborers.

The reliability of the results may be increased if the actual quantitative data of the intensity of infestation recorded for more number of years or more replications, are used which are the limitations of the present study. These may be kept in view for planning new experimental studies.

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