

Effect of rainfall and temperature distribution on incidence of American bollworm on cotton in Haryana

S. C. BHAN and K. L. KHARBANDA

Meteorological Centre, Chandigarh-160 022, India

(Received 16 January 2003, Modified 21 July 2003)

सार – इस शोध-पत्र में हरियाणा राज्य में कपास की फसल पर अमेरिकी बॉलवार्म के हमले का वर्षा और तापमान के उतार चढ़ाव के प्रभाव के संदर्भ में अध्ययन किया गया है। फसल की आरंभिक अवस्था से लेकर उसमें फूल और फल आने की अवस्था तक यदि सामान्य तापमान के साथ-साथ अच्छी वर्षा भी होती रहती है तो फसल के तैयार होने के समय पर इस कीट के हमले की अधिक संभावना रहती है। फसल के तैयार होने की अवस्था में जब भी इस कीट का हमला हुआ तब अध्ययन से यही पता चला है कि फसल के आरंभ से लेकर उसमें फूल फल आने की अवस्था तक सामान्य तापमान के साथ साथ अच्छी वर्षा भी हो रही थी इससे यही पता चला है कि फसल के आरंभ के समय भी तापमान और वर्षा की स्थितियों पर ही इस कीट का हमला निर्भर करता है।

ABSTRACT. The effect of rainfall and temperature distribution on the incidence of American bollworm on cotton in Haryana state has been studied. Higher rainfall coupled with moderate temperature from early vegetative stage till the early reproductive stage has been found to favour the incidence of the pest during the later stages of the crop. The weather conditions were nearly the same during the later stages (when the infestation is maximum) indicating that the distribution of rainfall and temperature during the early stages determines the infestation.

Key words – American bollworm, Cotton, Haryana.

1. Introduction

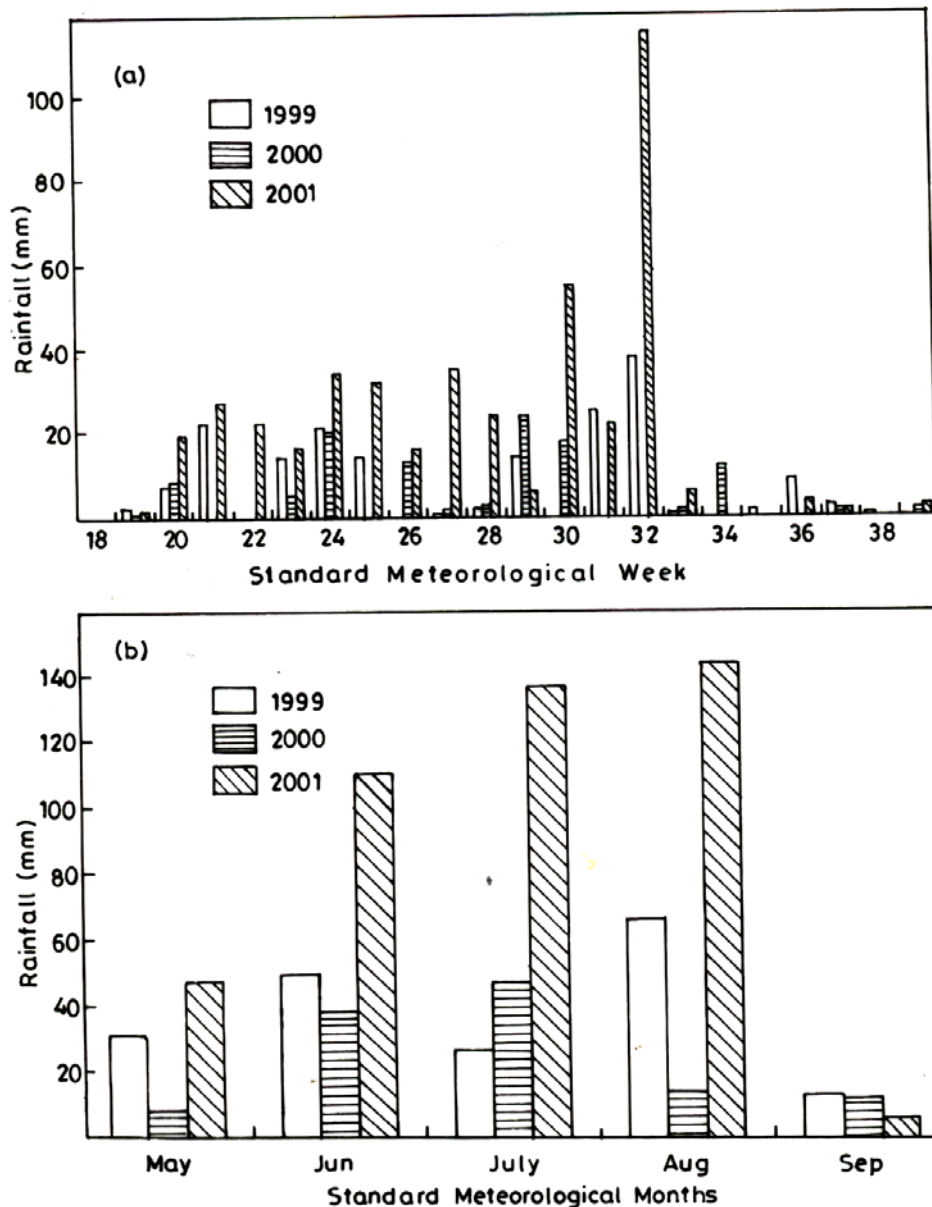
Cotton is one of the main cash crops of kharif season over north-west India. In Haryana, it is grown in more than 500 thousand hectares area; confined mainly to western parts of the state. The crop is affected by more than 100 species of insects (Pradhan, 1983). However, only some of these are of economic importance. Of late, American bollworm (*Helicoverpa armigera* Hub.) has emerged as the most serious pest of cotton over the state. Repeated severe infestations by this pest have resulted in drastic fall in the area under cultivation as well as in the production of crop in the state. The area under cultivation of has fallen from 653,000 hectares in 1996 to 583,000 hectares in 1998, and the production from 1,507,000 bales (of 170 kg. each) to 874,000 bales during the same period (Anonymous, 2001). The incidence of pest is highly affected by the weather condition prevalent during the crop season.

Since American bollworm has become the most serious pest of cotton compared to other pests (pink bollworm, spotted bollworm, jassid, white fly etc.) only recently, detailed studies on the pest weather relationships of this pest for all the agroclimatic regions of the country

are not available. However, in some recent studies, efforts have been made to study the ecology of the pest in certain parts of the country, particularly under control conditions (Chattopadhyay *et al.*, 1998; Chaudhary *et al.*, 1999 and Daware *et al.*, 1994). As the results of the control experiments generally differ from those under actual field conditions, the impact of weather (rainfall and temperature distribution) during the crop season on the incidence of American bollworm on cotton crop over western parts of Haryana are reported in the present communication. Since the developmental rhythms of the crop and the pest are different for different areas, the validity of the findings are area specific.

2. Materials and method

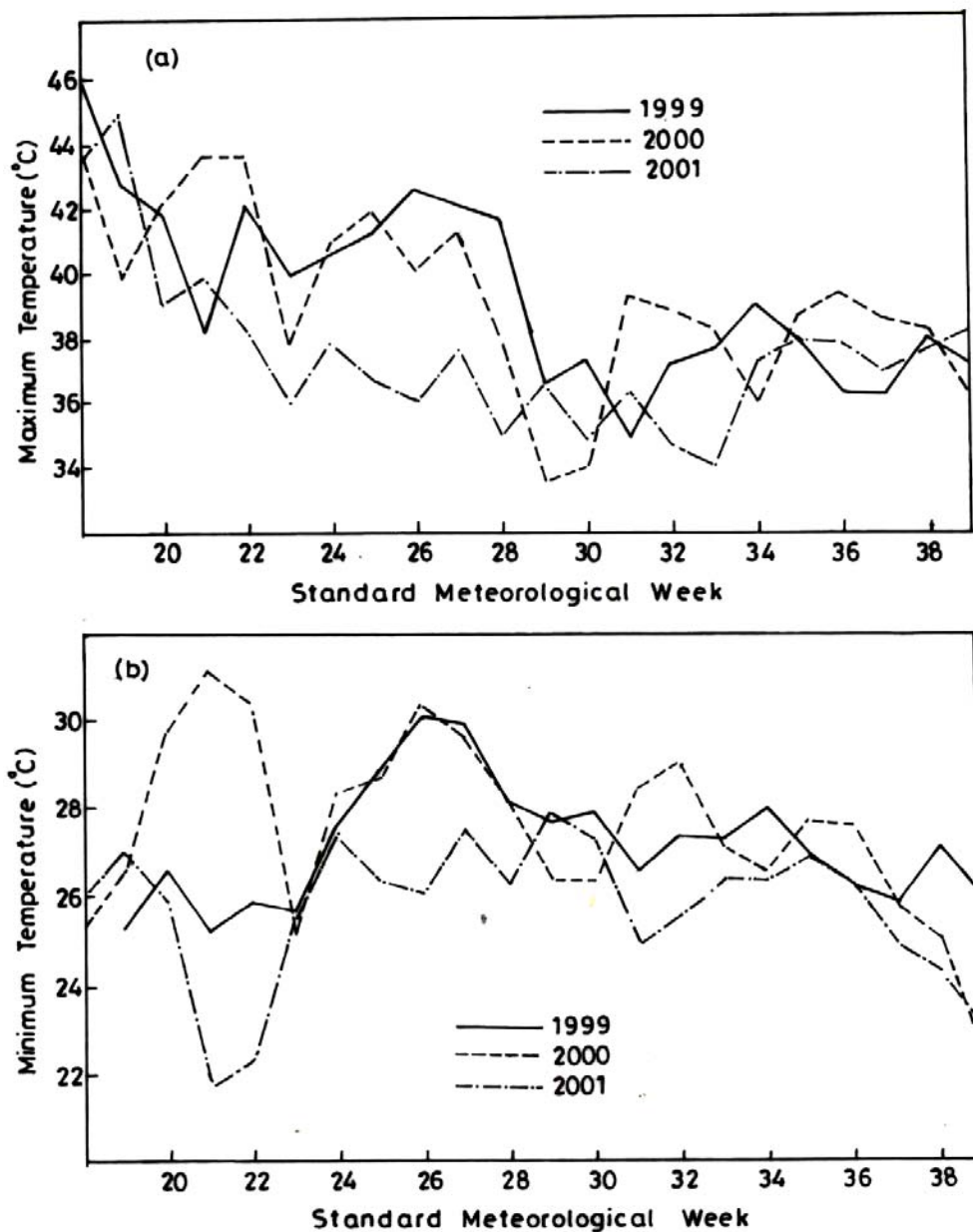
As quantitative data on the incidence of the pest under field conditions are generally not available, qualitative information on the incidence of American bollworm compiled by the Department of Agriculture, Haryana (Weekly weather – watch reports and monthly crop condition reports) based on field report have been used. These reports are available for the three crop season-1999, 2000 and 2001. The incidence is categorized as mild (< 20% of the crop infested), moderate (20% to 50%) and



Figs. 1(a&b). Rainfall distribution over Hisar district during the three crop seasons. (a) Weekly and (b) Monthly

severe (>50%). The reports indicate that there was only mild attack throughout the crop seasons of the 1999 and 2000, whereas moderate to severe attack of the pest was noticed during many weeks of September and October, 2001. The review of kharif crops - 2001 prepared by the Department of Agriculture, Haryana states – “due to severe incidence of American bollworm, about 55% of the cotton crop perished. Loss of production estimated to be as high as 778,000 bales”.

Weekly data of maximum and minimum temperatures of Hisar observatory (located in the cotton growing belt of the state) from sowing [first week of May – meteorological week (MW) 18] till boll formation (last week of September – MW 39); and weekly/monthly rainfall of Hisar district (averaged over 6 rain gauge stations) for the same period have been considered for the study. The rainfall data are shown in the Figs. 1(a&b) and the temperature data in Figs. 2(a&b).



Figs. 2(a&b). Temperature distribution over Hisar during the three crop seasons. (a) Maximum and (b) Minimum

3. Results and discussion

Fig. 1(a) shows that year 2001 received less rainfall than 1999 and 2000 during the first three weeks of May (early sowing stage). After that, the rainfall during 2001 was higher during most of the weeks till middle of August (early reproductive stage) compared to the previous two years. This type of rainfall distribution is also reflected in the monthly rainfall [Fig. 1(b)]. Afterwards, there was not much difference in the rainfall till the end of September

for all the three years. Figs. 2(a&b) shows that the maximum and minimum temperatures during 2001 remained lower than those in 1999 and 2000 during most of the weeks from the middle of May till middle of August. They remained nearly the same afterwards till the end of September.

Analysis of above rainfall and temperature distribution *vis-a-vis* severe incidence during 2001 and mild incidence during 1999 and 2000 indicates that the

higher rainfall coupled with moderate temperature from the early vegetative stage till the early reproductive stage favours the incidence of American bollworm in cotton crop. Chattopadhyay *et al.* (1998) have also reported that higher rainfall and lower maximum/minimum temperatures were favourable for peak incidence of American bollworm in cotton crop at Coimbatore. In the present case the severe infestation occurred during the months of September and early October in 2001 when the meteorological conditions were nearly the same as those during 1999 and 2000, however, the conditions before the severe incidence were significantly different during the year of severe incidence (2001) than those during the other two years. It brings out that the distribution of rainfall and temperature prior to the peak infestation is more important than that at the time of infestation.

As cotton is an indeterminate plant, higher rainfall and moderate temperatures during vegetative and early reproductive stages lead to excessive growth of the crop and make the crop more succulent. The excessive growth of the crop creates a favourable microclimate for rapid multiplication of the pest; and also the increased succulence of the crop makes it more susceptible to infestation. Also the physical nature of the excessively grown up cotton crop is such that proper coverage of the plant with pesticides is quite difficult. The combined effect of favourable macroclimatic conditions during the pre-infestation stage and the resultant favourable microclimate during the infestation stage seem to have resulted in severe incidence of American bollworm in Haryana during the year 2001.

It seems that with above analysis some forewarning/advisory on incidence of American bollworm in Haryana can be issued so that effective measures for prevention and control can be taken.

Acknowledgements

The authors are thankful to the Department of Agriculture, Haryana for supplying weekly and monthly crop condition reports.

References

- Anonymous, 2001, "Statistical abstracts of Haryana", Economic and statistical organization, Haryana, Chandigarh, 238-239.
- Chatopadhyay, N., Dubey, R. C. and Ravindra, P. S., 1998, "Meteorological parameters useful for forecasting of the incidence of American bollworm of cotton in two agroclimatic zones of India", *Vayu Mandal*, **28**, 1-2, 31-35.
- Chaudhary, G. B., Barpoda, T. M., Patel, J. J., Patel, K. I. and Patel, J. R., 1999, "Effect of weather activity on cotton bollworm in middle Gujarat", *J. Agrometeorol.*, **1-2**, 137-142.
- Daware, D. G., Suryawanshi, A. P., Changule, R. B. and Patel, M. S., 1994, "Incidence of cotton bollworm in relation to meteorological factors in Marathwada regions (MS)", *J. Cotton Res. Dev.*, **1**, 72-80.
- Pradhan, S., 1983, "Insect pests of crops", National book trust of India, New Delhi, 100-118.
-